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16.f.19.

John F. South.

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OUTLINES

OF

COMPARATIVE ANATOMY.

INTENDED PRINCIPALLY FOR THE USE OF STUDENTS.

By ANDREW FYFE.

EDINBURGH

Printed by J. Pillans & Son,

FOR ADAM BLACK, SOUTH BRIDGE STREET, EDINBURGH;
AND THOMAS UNDERWOOD, 32. FLEET STREET, AND
40. WEST SMITHFIELD, LONDON.

1818.

7-1302
TOMKIS

ADVERTISEMENT.

The Author thinks it necessary to acknowledge here, that much of the information contained in the following Outlines is derived from modern Zootomists, particularly Blumenbach and Cuvier, whose works deserve to be carefully perused by every one, who proposes to make Comparative Anatomy a particular object of pursuit.

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A R-

ARRANGEMENT OF ANIMALS,

ACCORDING TO

THEIR ANATOMICAL STRUCTURE.

ANIMALS are divided into, 1. Such as *have* a *Vertebral Column* and *Red Blood;* and, 2. Those which *want Vertebræ,* and have in general *Colourless Blood.*

Vertebral Animals are subdivided into those with *warm,* and such as have *cold Blood.*

In warm-blooded Animals, there are two classes, *Mammalia* and *Birds.*

Cold-blooded Vertebral Animals consist also of two classes, *Reptiles* and *Fishes.*

Invertebral Animals consist of *Mollusca, Crustacea, Insects, Worms,* and *Zoophytes.*

CLASS

CLASS I.

A.

Vertebral warm-blooded Animals.

Mammalia.

In the Mammalia, the Females are viviparous, and suckle their young. The greater number of them are Quadrupeds, and these, for the most part, are covered with Hair, and walk on the Earth; the rest have a sleek Skin, and inhabit the Ocean. They consist of the following Orders:

1. Bimanum.—Two-handed, Thumbs separate on the Superior Extremities only.

   Homo, Man.

2. Quadrumana.—Four-handed, the Thumb or Great Toe capable of being opposed to the other Fingers or Toes on each of the four Extremities.

   Simiæ, Apes, which have no Tails; Baboons, which have short Tails; and Monkeys, which have long Tails.

   Lemur, Makis or Macoucos, (a kind of link between the Simiæ and other Quadrupeds; having the hand-like Paw and Flat Nail of the former, and the crooked Nail of the latter.)

3. Brydapoda.—Slow-moving Animals, with their Bodies generally covered by a hard crust. Some want the Incisor Teeth; others want the Incisors and Cuspidati; in others, the Jaws are destitute of Teeth.

   Bradypus, or Sloth.

Merme-

Mermecophaga, Ant-eaters.
Manis, Scaly Lizard, or Pangolin.
Dasypus, Armadillos.
Ornithorrynchus, Duck-billed Animal.

4. CHEIROPTERA.—Having the Fingers elongated, for the expansion of Membranes which act as Wings.
Vespertilio, Bat.

5. GLIRES, seu RODENTIA.—Gnawing Animals, having large Incisors in each Jaw, by which they divide hard substances. Canine Teeth wanting.
Sciurus, Squirrel.
Glis, seu *Myoxus*, Dormouse.
Mus, Mouse and Rat.
Marmota, Marmot.
Cavia, Guinea Pig.
Lepus, Hare and Rabbit.
Jaculus, Jerboa.
Castor, Beaver.
Kangurus, Kanguroo.
Hystrix, Porcupine.

6. FERÆ.—Predaceous and Carnivorous Animals; large Canine Teeth, the Molares forming pointed prominences for tearing and cutting the Food.
Erinaceus, Hedge-hog.
Sorex, Shrew.
Talpa, Mole.
Meles, Badger.
Ursus, Bear.
Didelphis, Opossum.
Viverra, Weasel, Ferret, Pole-cat, Civet.
Mustela, Skunk, Stoat, &c.
Canis, Dog, Wolf, Jackal, Fox, Hyena.

Felis,

Felis, Cat, Lion, Tiger, Leopard, Lynx, Panther, &c.

Lutra, Otter.

Phoca, Seal, or Sea-calf.

7. SOLIDUNGULA, seu SOLIPEDA.—A single Toe or Hoof on each Foot. Six Incisor Teeth in each Jaw. All herbivorous.

Equus, Horse, Ass, Zebra, Quagga, &c.

8. PECORA, seu BISULCA, seu RUMINANTIA.—Two Toes or Hoofs on each Foot. No Incisors in the Upper Jaw. All herbivorous, and ruminate the Food.

Camelus, Camel, Dromedary, Lama.

Ovis, Sheep.

Capra, Goat.

Antilope, Antelope, Chamois.

Bos, Ox, Buffalo.

Giraffa, Girraf or Camelopard.

Cervus, Elk, Deer kind.

Moschus, Musk.

9. BELLUÆ, seu PACHYDERMATA.—Animals of unshapely form, and tough thick hide. Have more than two Toes. Incisors in both Jaws. Some have enormous Tusks.

* *Sus*, Pig, Peccari, Babiroussa.

Tapir, Tapir.

Elephas, Elephant.

Rhinoceros, Rhinoceros.

Hippopotamus, River-horse.

Trichecus, seu *Morse*, Walrus, or Sea-cow.

10. CE-

* The *Sus Scrofa Domestica* of Linnæus has undivided Hoofs.

10. Cetacea.—Whale kind, living in the Sea, and breathing through a hole on the top of the Head. Bodies in the form of Fishes. Tail flattened horizontally.

Monodon, Narwal, or Sea-unicorn.
Balæna, proper Whales.
Physeter, Cachalot, Spermaceti Whales.
Delphinus, Dolphin and Porpoise.

CLASS II.

Birds.

Birds are Oviparous; have two Feet and two Wings. They have a horny Bill, and are covered with Feathers and Down. They form two divisions, *Terrestrial* and *Aquatic*.

Terrestrial Birds.

1. Accipitres.—Birds of prey, with strong hooked Bills and curved Talons.

Vultur, Vulture.
Falco, Falcon, Hawk, Kite.
Strix, Owl.
Lanius, Shrike or Butcher Bird.

2. Levirostres.—Light-billed Birds, having a large, light, hollow Bill.

Psittacus, Parrot kind.
Ramphostos, Toucan.
Buceros, Rhinoceros Bird.

3. Picæ, or Pies.

Picus, Wood-pecker.

Junx, Wry-neck.
Sitta, Nuthatch.
Alcedo, King's-fisher.
Trochilus, Humming Birds.
&c. &c.

4. Coraces.—Coraceous Birds, the character not defined.

Corvus, Crow, Raven, Jackdaw, Magpie, Jay, &c.
Coracias, Roller.
Paradisea, Birds of Paradise.
Cuculus, Cuckoo.
&c. &c.

5. Passeres.—Small Singing-birds, &c. something in the form of the Passer, or Sparrow.

Alauda, Lark.
Sturnus, Starling.
Turdus, Thrush, Blackbird.
Emberiza, Bunting.
Fringilla, Finches, Canary Bird, Linnet, Sparrow.
Motacilla, Nightingale, Red-breast, Wren.
Hirundo, Swallows, Martins, &c.
Caprimulgus, Goat-sucker, &c.

6. Gallinæ.—Gallinaceous Birds, mostly domesticated; possessing a large Crop and strong Muscular Gizzard.

Columba, Pigeons.
Tetrao, Grous, Quail, Partridge.
Numida, Guinea Fowl.
Meleagris, Turkey.

Pavo.

Pavo, Pea-fowl.

Ottis, Bustard.

7. Struthiones.—Struthious Birds. The largest of the class; with Wings too small for flight.

Struthio, Ostrich.

Casuarius, Cassowary.

Aquatic Birds.

1. Grallæ.——Waders; frequenting marshes and streams; long naked Legs; long Neck; cylindrical Bill of different lengths.

Ardea, Crane, Stork, Heron, Bittern.

Scolopax, Woodcock, Snipe, Curlew

Tringa, Lapwing, Ruffs, and Reeves

Charadrius, Plover.

Fulica, Coot.

Rallus, Rail.

Phœnicopterus, Flamingo.

Tantalus, Tantalus, &c.

2. Anseres.—Swimming-birds; web-footed. Bill broad and flat.

Colymbus, Diver.

Larus, Gull.

Procellaria, Petrel.

Diomedea, Albatross.

Pelecanus, Pelican, Cormorant.

Anas, Swan, Duck, Goose.

Mergus, Merganser or Goosander.

Alca, Auk, Puffin.

Aptenodyta, Penguin.

CLASS III.

B.

Vertebral cold-blooded Animals.

Reptiles.

Their Body is covered with a Shell, or with Scales, or is quite naked. They have neither Hair, Mammæ, Feathers, nor radiated Fins. They breathe through the Mouth and Nose by means of Lungs; are oviparous and amphibious. They are divided into *Reptiles* strictly so called, and *Serpents*.

1. Reptilia.—Having generally four, seldom two Feet.
   Testudo, Tortoise, Turtle.
   Rana, Frog, Toad.
   Lacerta, Lizards, Crocodile, Chamæleon, Newt, Salamander, Iguana, &c.
2. Serpentia.—No Feet. Some are ovi-viviparous, having the Egg hatched in the Oviduct.
   Crotalus, Rattle-snake.
   Boa, huge Serpents of India and Africa.
   Coluber, Viper.
   Anguis, blind Worm.
   Amphisbæna, Amphisbæna.
   Cæcilia, Cæcilia.

CLASS IV.

They possess Branchiæ or Gills in place of Lungs, live in water, and do not breathe. Body scaly or naked. Have radiated Fins in place of Feet and Wings. They are divided into those with Cartilaginous, and such as have Osseous Skeletons.

Cartilaginous Fishes.

1. Chondropterygii.—Having Branchiæ fixed, and no Gill-flap.
   - *Petromyzon*, Lamprey.
   - *Gastrobranchus*, Hag-fish.
   - *Raja*, Skate, Torpedo, Stingray
   - *Squalus*, Shark, Saw-fish.
   - *Lophius*, Sea-devil, Frog-fish.
   - *Balistes*, File-fish.
   - *Chimæra*, Sea-monster.
2. Branchiostegi.—Having Branchiæ free, and a Gill-flap.
   - *Accipenser*, Sturgeon, Beluga.
   - *Ostracion*, Trunk-fish.
   - *Tetrodon*, Sun-fish.
   - *Diodon*, Porcupine-fish.
   - *Cyclopterus*, Lump-sucker.
   - *Centriscus*, Trumpet-fish.
   - *Syngnathus*, Pipe-fish.
   - *Pegasus*, Pegasus.

Osseous Fishes.

Osseous Fishes are arranged according to the situation of their Fins.

1. Apodes.—No Ventral Fins.
   - *Muræna*, Eel-kind.
   - *Gymnotus*, Electrical Eel.
   - *Anarrhichas*, Sea-wolf.
   - *Xiphias*, Sword-fish.
   - *Ammodites*, Launce.
   - *Ophidium*, Ophidium.
   - *Stromateus*, Stromateus.
   - *Trichiurus*, Trichiurus.
2. Thoracici.—Ventral Fins directly under the Thoracic.
   - *Echeneis*, Sucking Fish.
   - *Coryphæna*, Dorado.
   - *Zeus*, Dory.
   - *Pleuronectes*, Flounder, Plaice, Dab, Holibut, Sole, Turbot.
   - *Chætadon*, Chætadon.
   - *Sparus*, Sparus.
   - *Perca*, Perch.
   - *Scomber*, Mackerel, Bonito, Tunny.
   - *Mullus*, Mullet.

   &c. &c.
3. Abdominales.—Ventral Fins behind the Thoracic; chiefly inhabit fresh water.
   - *Cobitis*, Loach.
   - *Silurus*, Silurus.

Salmo,

Salmo, Salmon, Trout, Smelt.
Esox, Garfish, Pike.
Clupea, Herring, Sprat, Shad, Anchovy.
Cyprinus, Carp, Tench, Gold-fish, Minnow, &c.

4. Jugulares.—Ventral Fins in front of the Thoracic.
Gadus, Haddock, Cod, Whiting, Ling.
Uranoscopus, Star-gazer.
Blennius, Blenny.
Callionymus, Dragonet.
Trachinus, Weaver.

CLASS V.

C.

Invertebral and cold-blooded Animals.

Mollusca.

Mollusca have soft fleshy Bodies, from which they derive their name. No articulated Members. Have a Heart and Blood-vessels; Brain and Nervous System. Respire by means of Gills. Some are destitute of an external covering, and called *Mollusca Nuda;* others are inclosed in a Shell, and termed *Mollusca Testacea.* When the Shell consists of one, two, or more separate pieces, it is called Univalvular, Bivalvular, and Multivalvular. They are divided into the following orders:

1. Cephalopoda.—The Head surrounded by the Feet, which are the Tentacula.
Sepia, Cuttle Fish.

Argonauta, Paper Nautilus.
Nautilus, Pearl Nautilus.

2. Gasteropoda.—The Head free. They crawl upon the Belly, which serves them as Feet. They are univalvular, or multivalvular. None are bivalvular.

Limax, Slug, or naked Snail.
Aplysia, Aplysia.
Doris, Sea Lemon, &c.
Clio, Clio.
Pattella, Limpet.
Helix, Snail.
Haliotis, Venus's Ear.
Murex, Caltrop, or Rock-shell.
Scrombus, Screw.
Buccinum, Whelk.
&c.

3. Acephala.—No distinct Head. Bivalvular.

Ascidia, Ascidia.
Thalia, Thalia.
Ostrea, Oyster.
Solen, Razor-shell.
Cardium, Cockle.
Mytilus, Muscle.
&c.

CLASS VI.

Crustacea.

Crustacea possess a hard external covering, and numerous articulated Limbs. Antennæ and Palpi. A Heart,

Heart, with Circulating Vessels and Gills. A Nervous System.

Cancer, Crab, Lobster, Cray-fish, Shrimp.

Monoculus, having sometimes but one Eye, or two so close as to appear but one.

CLASS VII.

Insects.

Insects have Antennæ, Palpi, and articulated Limbs. Those which fly metamorphose, or pass through certain changes in their Body, before they become complete Insects. They breathe by means of Tracheæ, but have no Cellular Lungs. They have a Nervous System and Blood-vessels, but no Heart. They are divided into the following orders :

1. Coleoptera.—Having a hollow horny Case, under which the Wings are folded.
   Scarabæus, Beetle.
   Lucanus, Stag-beetle.
   Dermestes, Dermestes.
   Coccinella, Lady-bird.
   Curculio, Weevil.
   Lampyris, Glow-worm.
   Meloe, Spanish Fly.
   Staphylinus, Staphylinus.
   Forficula, Ear-wig.
2. Hemiptera.—Four Wings, either stretched straight out, or resting across each other.
   Blatta, Cockroach.
   Gryllus, Locust, Grasshopper.

Fulgora,

Fulgora, Lantern-fly.
Cimex, Bug.
&c.

3. Lepidoptera.—Soft hairy Body, and four expanded Wings.
Papilio, Butterfly.
Sphinx, *Phalæna*, } Moths.

4. Neuroptera.—Four reticulated Wings.
Libellula, Dragon-fly.
Ephemera, Ephemera.
&c.

5. Hymenoptera.—Generally possessing a Sting.
Vespa, Wasp, Hornet.
Apis, Bee.
Formica, Ant.
Termes, White Ant.
Ichneumon, Ichneumon.
&c.

6. Diptera.—Two Wings.
Œstrus, Gad-fly.
Musca, Common Fly.
Culex, Gnat, Mosquito.
Hippobosca, Horse Leech.
&c.

7. Aptera.—No Wings.
Podura, Spring-tail.
Pediculus, Louse.
Pulex, Flea, Chigger.
Acarus, Tick, Mite.
Aranea, Spider.
Scorpio, Scorpion.
&c.

CLASS VIII.

Worms.

Worms have neither Limbs, Antennæ, nor Heart. Some have Circulating Vessels without Nerves; others have both Vessels and Nerves. They do not metamorphose. They may be divided into *Internal*, or such as inhabit the Bodies of other Animals, and *External*.

1. Interna.—Some have distinct Vessels for carrying in their nourishment; but few of them have any visible Nerves.
   Gordius, Guinea-worm, Hair-worm.
   Ascaris, Thread-worm, Round-worm.
   Trichuris, seu *Tricocephalus*.
   Fasciola, Fluke-worm.
   Tænia, Tape-worm.
   Hydatis, Hydatid.
2. Externa.—Have Circulating Vessels; a Nervous Cord with Ganglia; an elongated Body composed of Rings.
   Aphrodita, Sea-mouse.
   Hirudo, Leech.
   Nereis, Nereis.
   Nais, Nais.
   Planaria, Planaria.
   Lumbricus, Earth-worm.
   &c.

CLASS

CLASS IX.

Zoophytes.

Zoophytes, or Animal Plants, resemble Vegetables in their external structure, but are real Animals. The greater part of them are inhabitants of the Sea. They have the parts of their Bodies radiated, with their Mouth in the centre of the Radii. They have no articulated Limbs, nor Heart, though some have Vessels running from the Stomach through the Body. They have neither Brain nor Nerves. They consist of the following Orders:

1. Echinodermata.—Covered by a hard and Coriaceous Skin.
   - *Echinus*, Sea-urchin or Egg.
   - *Asterias*, Star-fish.
   - *Holothuria*, Holothuria.
   - *Sipunculus*, Sipunculus.
2. Gelatinous Zoophytes.—With Stomachs hollowed out of the Body.
   - *Medusa*, Sea-blubber, Sea-nettle.
   - *Actinia*, Sea-anemone.
   - *Hydra*, Fresh-water Polypus.
3. Infusoria.—Animalcula of Infusions.
   - *Vorticella*, Wheel-animal.
   - *Brachionus*, Brachionus.
   - *Vibrio*, Eel of Vinegar.
   - *Volvox*, Volvox.
   - *Monas*, Monas.

   &c.

4. Zoo-

4. Zoophytes strictly so called.—The productions of Polypi, having a Medullary Body traversed by a Horny Substance, and the Branches terminated by the Polypi.

Tubularia, Tubulated Coralline.

Sertularia, Sea-moss.

&c.

5. Eschara.—Where each Polypus is contained in a Calcareous or Horny Shell, without any central Axis.

Flustra, Matweed.

Corallina, Common Corallines.

&c.

6. Ceratophyta.—Where there is a Horny Axis, covered with a Fleshy Substance, from the cavities of which Polypi occasionally appear.

Gorgonia, Sea-fan.

Corallium, Coral.

Pennatula, Feather-like Coralline, or Sea-pen.

&c.

7. Lythophyta.—In which there is a Stony Axis, with cavities serving as the Receptacles of, and formed by, Polypi.

Madripora, Madripore.

Millepora, Millepore.

8. Spongia.—With a Spongy, Friable, and Fibrous Substance.

Alcinum, Alcinum.

Spongia, Sponge.

PART I.

OF

MAMMALIA.

OF THE BONES IN GENERAL.

The Bones of all the Mammalia are nearly of the same colour and general appearance as those of the Human Body. In some, however, as the Dentes Molares of the *Elephant*, and the larger Herbivorous Animals, the colour is observed to vary in different parts of the same Bone.

They are covered with a Periosteum, and contain Marrow, which in the Whale tribe is fluid.

Ossification varies in rapidity in different Animals, and in different Bones of the same Animal. In the Internal Ear, it is complete sooner than in any other part, and the Bones of this Organ surpass all others in density.

Bones acquire their complete formation sooner or later, according to the length of time at which the Animal attains its full growth.

The Bones of some of the larger species are of a coarser texture than in the Human Body, especially those of the *Whale tribe*, in which the Fibrous Structure is rendered very distinct by steeping them in water.

The *Cetacea* and *Seal* have no cavities even in their long Bones.

The Horns of some Animals, as the *Stag*, are of the same nature with the Bones, but internally have neither Cavities nor Marrow.

The component parts of the Bones of all Mammalia correspond in a great measure with those of the Human Body; but their relative proportions are found to differ, not only in the various Genera and Species, but in the different Bones of the same individual. The Horn of the Stag is similar to Bone, not only in its texture, but also in its component parts, in which there is a large proportion of Gelatine.

OF THE SKELETON.

THE Skeleton of Mammalia is divided into Head, Trunk, and Extremities; the last of which, in Quadrupeds, owing to the horizontal situation of the Animal, are denominated *Anterior* and *Posterior*, the former corresponding to the Superior, the latter to the Inferior Extremities of the Human Body.

BONES OF THE HEAD.

Cranium.—Next to the Human Species, the Ape tribe is found to have the largest Cranium in proportion to the Face; but the Cranium is small here when compared with that of the Human Body. While, in a *European Man*, the Area of a longitudinal vertical section of the Cranium is almost four times larger than that of the Face, (the Lower Jaw excluded); in the *Monkey* it is little more than double. In most of the *Feræ* it is nearly equal. The *Glires*, *Solipeds*, *Pecora*, and *Belluæ*, have it less. It is only about a half in Pecora, and little more than a fourth in the Horse; and in proportion as the Cranium becomes less than the Face, the Animal is observed to become more stupid or ferocious; though to this rule there are many exceptions.

The Facial Angle assists likewise in discovering the proportion between the Cranium and Face. It is more obtuse in the Human Species, and more acute as we descend in the scale from Man, till in the lower classes of Vertebral Animals it disappears. In the Human Adult European, the angle is 85°; in the *Ourang-outang* 67°; in some of the other *Monkeys*, it goes as low as 30°; and among the other Genera of Quadrupeds, it is in some only 20°.

The Temporal and Occipital Ridges, or Cristæ, vary considerably in different Quadrupeds. They serve chiefly for the attachment of the strong Temporal and Cervical Muscles attached to them, and are most con-

siderable in Carnivorous Animals. The situation and direction of the Foramen Magnum Occipitis also vary considerably among some Animals. In most Quadrupeds it is placed obliquely at the extremity of the Cranium, with its posterior edge turned upward. Animals going upon all fours have the Occipital Foramen situated farther back, in proportion as the Face is elongated; to compensate for which, the Head is suspended by strong Muscles, and also by the Ligamentum Nuchæ placed upon the upper part of the Neck.

The *Ape tribe*, but more particularly the *Ourang-outang*, which forms a medium between Man, who walks erect, and Quadrupeds that move in the horizontal posture, have this passage nearer the centre of the base of the Cranium than it is in any other Animal, in consequence of which, they can support an erect posture longer than other Quadrupeds.

The number of Bones here is in general the same as in Man; but Ossa Triquetra are seldom seen. All the Ape tribe have eight distinct pieces. In the *Feræ*, and many others, the Parietal Bones are united at an early period; but in many Quadrupeds, particularly *Horned Cattle*, the Os Frontis is divided by the Sagittal Suture for a considerable time. In some, as the *Feræ* and *Horse*, there is only one Parietal Bone; while in others they are joined by accretion to the Os Occipitis. The Bones of the Cranium, in the *Elephant*, are soon united into one piece, so as to appear like a single Bone. In the *Cetacea*, the Parietal, Occipital, and Temporal Bones, are early united. In a great variety of the Animals

mals of this class, the portion of the Os Temporis, containing the internal parts of the Ear, is separated from the rest of the Bone by a Suture. In the *Cetacea*, the connecting medium is so soft, that the parts can be readily removed from each other.

In the order *Glires* or *Rodentia*, the Temporal Bone has no Carotic Canal, the Artery entering between the Temporal and Sphenoid Bones. There is a considerable variety, also, among the other Foramina at the base of the Cranium; those of the Cribriform Plate of the Ethmoid Bone being, in number and size, in proportion to the acuteness of smell. In the *Cetacea*, the Cribriform Plate of this Bone is wanting.

The three large Fossæ at the inside of the Base of the Cranium in Quadrupeds, are more superficial as the Animal is removed from Man. In many *Carnivorous* Animals, the Cavity for the Cerebellum is separated from that of the Cerebrum by a broad Osseous Lamina, projecting from the inner side of the Cranium.

The Scull of the *Elephant* presents a remarkable appearance; the two Tables are separated from each other to a considerable distance, and the space is occupied by numerous Osseous Plates, that form large Cells, communicating with each other, and then with the Eustachian Tube, which leads into the Throat. These Cells are filled with air, which, without adding to the weight of the Head, allows it to be increased in size, for the attachment of the strong Muscles necessary for the motion of the Lower Jaw and Proboscis.

In the *Cetacea*, the Scull is very globular, and the

Face flat and small, the part analogous to the Nose being upon the summit of the Head.

Face.—The size and form of the Face depends, in a great measure, on the figure and extent of the Upper Jaw. Quadrupeds, the *Ape* tribe not excepted, have two Bones in the Face in addition to those found in Man. These contain the roots of the Dentes Incisores, when such are present, but exist also in Animals destitute of Teeth. They are termed *Ossa Intermaxillaria*, *Ossa Incisoria*, vel *Labialia*, and are situated between the Ossa Maxillaria; but the Suture which separates these from the Maxillary Bones is obliterated in some Animals at an early period of life.

In the *Ourang-outang*, as well as in Mammalia in general, the Jaws are longer than in the Human Body. The Elongation is produced by the depth and situation of the superior Maxillary Bones, and increases in Quadrupeds in proportion as they recede from Man. When standing in the ordinary or horizontal posture, the Head of the Quadruped is supported by Muscles, and by the Ligamentum Nuchæ, which in general becomes stronger according to the weight of the Head.

The prolongation of the Bones of the Face may be determined by the Facial Angle, which becomes more acute according to the length of the Face.

The Face of the *Feræ*, and of several other Quadrupeds, differs from that of the *Ape*, in having the Nasal Processes of the superior Maxillary Bones broader, which removes the Orbits to the sides of the Head;—in the Orbitar Surface of these Bones not forming the under, but the anterior parts of the Orbits;—in the

Ossa

Ossa Malarum not being articulated with the Os Frontis, nor Os Sphenoides, but only contributing to form the Zygomatic Arches and the inferior edges of the Orbits;—in the Orbits not being inclosed below and behind, but communicating with the Temporal Fossæ;—in the Ossa Palati forming a considerable proportion of the inner part of the Orbits, and supplying the want of an Os Planum of the Ethmoid Bone.

The Lower Jaw of Quadrupeds deviates particularly from that of man, in being destitute of a Chin, and is also longer in proportion to the Cranium. The Condyles are found to vary according to the nature of the Food the Animal has to manducate, and the strength of the Muscles fixed to the Jaw. In the *Feræ*, they are so locked in by the fore and back parts of their Articular Cavities, that rotatory motion is entirely prevented; the Jaw moving only in a vertical direction, which is all that is necessary for the tearing and cutting of Animal Substances. In many *Herbivorous Animals* they are rounded, for admitting motion in every direction, so as to adapt them for grinding the Food. In many of the *Glires* they are parallel to each other, and placed in a longitudinal direction, by which the Incisores of the Lower Jaw can move horizontally, and advance or recede upon those of the Upper Jaw, so as to break the hard substances upon which these Animals frequently live. In many of the Mammalia, as the *Feræ*, &c. the lateral portions of the Jaw are connected by Cartilage for life; but in the *Ape tribe*, *Horned Cattle*, &c. they are united into one piece. The most singular form of this

this Bone is that of the Duck-bill appearance which it has in the *Ornithorrynchus*.

Os Hyoides.

The Os Hyoides has the same parts in general as in Man. It can be divided into Body and Cornua; but in many Animals, the long Cornua are so united with the Body, as not to be distinguished from it. Those corresponding to the small Appendices in Man are here larger than the other Cornua, and, being articulated before them, are distinguished by the name of *Anterior*, the other being called the *Posterior*. The first are fixed, on each side, to the Styloid Process of the Temporal Bone, or to a slender Bone supplying its place.

In the *Ourang-outang*, the Os Hyoides is nearly as in Man. It varies in the other *Apes*. In the *Carnivora*, it is generally long and slender. In the *Solipeds*, the Posterior Cornua and Body form an Arch, from which a long Process descends; the Anterior Cornua are short, and are directed forward to be articulated with the Styloid Processes.

In *Ruminants*, the Posterior Cornua unite with the Body into an Arch, which has a Tuberosity in the middle of its inferior part; the Anterior Cornua have each two pieces of unequal length, the short one being articulated with the Styloid Process.

In *Amphibious* Quadrupeds, as the *Seal*, the Body of the Os Hyoides is slender; the Posterior Cornua are continued in an Arch with the Body; the Anterior are formed of three Bones.

The

The *Cetacea* have also their Os Hyoides; with its Anterior and Posterior Cornua, which are of considerable length, and of a particular form.

TRUNK.

The Trunk in Mammalia, as in the Human Body, is divided by Anatomists into Spine, Pelvis, and Thorax, the first of which is the most constant part of the Skeleton. The Spine has the same number of Cervical Vertebræ in the different individuals of this class, as in the Human Body, excepting the *three-toed Sloth*, which, instead of seven, has nine.

In the *Ape tribe*, the *Cervical Vertebræ* differ from those in Man, chiefly in the Spinous Processes being proportionally stronger, and not forked. In the *Feræ*, the Spinal Holes are almost in the Bodies of the Vertebræ. The first and second Vertebræ in these Animals are remarkable, the former for the strength of its Transverse, the latter for that of its Spinous Processes; these parts affording attachment to the powerful Muscles which correspond with the other parts in enabling the Animal to seize its prey, or defend itself.

In the *Armadillo*, and other Animals of this order, the six last Cervical Vertebræ are in a manner soldered together, and have a kind of Groove in which the Esophagus is lodged. In the *Cetacea*, the Bodies of the Cervical Vertebræ are remarkably thin, and two or three of them are frequently anchylosed.

The *Dorsal Vertebræ* in *true Quadrupeds* have the anterior

anterior Spinous Processes augmented, in proportion as the Head is heavy or joined to a long neck, for the more advantageous attachment of the Muscles and the Ligamentum Nuchæ. We have examples of this in the *Elephant*, *Ox*, and *Camel*, in which they are remarkably long.

The *Lumbar Vertebræ* vary much in number in the different species of this class, as will be seen in the Table annexed. The Spinous and Transverse Processes are directed forwards in the same angles; as, for example, in the *Dog* and *Cat*. The size of the Transverse Processes is considerable in some, as the *Ox* and *Horse*, to give attachment to the strong Muscles of the Loins.

The *Os Sacrum* varies more in appearance than either of the former sets of Vertebræ; the number not being the same, even in the different species of the same Genus. It is generally narrower in proportion than in Man, but wider in such Genera as occasionally stand erect, as the *Ape*, *Bear*, &c. The Spinous Processes are longer in most of the *Feræ* than in Man. In most *Ruminants*, they almost form a continued crest.

In the greater part of the *Ape* tribe, it has one or two pieces fewer than in the Human Body. In the *long-tailed* Ape, indeed, there are six; but in the *Ourang-outang* there are only three.

In the *Horse*, it is remarkable for the long Lateral Processes at its anterior extremity.

The *Cetacea* want the Pelvis, of course the Sacrum.

The *Os Coccygis* is extended to form the Tail, which, in many Quadrupeds, consists of a great number

ber of pieces; and these are of two kinds, one which has a Spinal Canal, and another in which there is no perforation. In such *Apes* as want Tails, this Bone is found to have at most three pieces; but these are perforated for the passage of the Spinal Marrow and Nerves.

In other Quadrupeds, the Vertebræ of the Tail nearest the Sacrum are perforated for the Spinal Marrow, and have Articular, Transverse, and Spinous Processes, while the other, diminishing gradually in size to the end of the Tail, have only small Processes for the insertion of the Muscles.

In Animals with prehensile Tails, as some of the *Ape tribe*, *Opossum*, &c. there are frequently small Processes, or even supernumerary Bones, for giving proper direction to the Muscles.

In the *Beaver*, where the Tail is used as a Trowel, the Caudal Vertebræ are remarkable for the size of the Transverse Processes.

The following Table gives the number of the Vertebræ found in a few of the Species of this Class.

SPECIES.	Cervical.	Dorsal.	Lumbar.	Sacral.	Caudal.	
Ourang-outang,	7	12	4	3	4	
Other Apes,	7	11-14	3-8	1-6	3-32	
Two-toed Sloth,	7	23	2	4	7	and upwards.
Three-toed do.	9	14	4	3	13	
Bat, -	7	11-12	4-7	1-4	0-12	
Rat, -	7	12-13	7	3-4	23-26	
Mouse, -	7	12	7	4	24	
Hare, -	7	12	7	4	20	
Rabbit, -	7	12	7	2	20	
Mole, -	7	13	6	7	11	
White Bear,	7	13	6	7	11	
Brown Bear,	7	14	6	5	5	and upwards.
Weasel, -	7	14	6	3	14	
Dog, -	7	13	6	3	22	
Wolf, -	7	13	7	3	19	
Fox, -	7	13	7	3	20	
Cat, -	7	13	7	3	22	
Lion, -	7	13	6	3	23	
Tiger, -	7	13	7	4	19	
Otter, -	7	14	6	3	21	
Seal, -	7	15	5	2	12	
Horse, -	7	18	6	2	17	
Ass, -	7	18	5	2	17	
Mule, -	7	18	5-6	2	17	
Camel, -	7	12	7	4	17	
Sheep, -	7	13	6	4	16	
Goat, -	7	13	6	4	12	
Ox, -	7	13	6	4	16	
Deer, -	7	13	6	3	11	
Pig, -	7	14	5	3	5	and upwards.
Elephant, -	7	20	3	4	24	

Dolphin and Porpoise, in all 66.

The *Pelvis* is narrower in proportion, and has less of the bason appearance, in the whole of this Class, than it has in Man, the Ape tribe not excepted.

In some the Ossa Ischia are so long, as to have the Acetabulum almost in the centre of the Ossa Innominata. In the species of *Apes* which are frequently in a sitting posture, there are broad and flat Tuberosities belonging to the Ossa Ischia.

The Ossa Ilia of the order *Bradypoda* are somewhat of a prismatical form; the *Sloth*, *Armadillo*, and some others, have the Tuberosities of the Ischia so much approximated, that the Ischiatic Notches are converted into a complete Foramen. In the *Ant-eaters*, on the contrary, the Ossa Pubis are at a distance from each other, as in Birds.

In the *Glires*, the Abdominal Surface of the Ossa Ilia is turned towards the Spine. They are concave externally, and in some are of a prismatical form. The *Beaver* and the *Kanguroo* have the Ossa Pubis joined together by an Accretion of Substance. The *Marmot*, *Kanguroo*, and *Opossum*, are remarkable in the diminutive size of the Brim of the Pelvis, and proportional magnitude of the Foramen Thyroideum; but still more so on account of two long narrow flat Bones, articulated with the Ossa Pubis: these give origin to particular Muscles in the Female, for supporting the Pouch that contains the Young. They are also said to belong to the male; at least to some of the species. Marsupial Bones have also been found in the *Ornithorrynchus*, or Duck-billed Animal.

The

The *Feræ* have the Abdominal Surface of the Ossa Ilia turned towards the Spine. They are nearly as broad behind as before, and are hollow externally. In the *Mole*, the Ossa Innominata are almost cylindrical, and so close together, that the Parts of Generation are situated on the Abdominal side of the Brim of the Pelvis. The *Bear*, which rests much on its Buttocks, has the Pelvis more similar to that in man, than in many others. In the *Otter* and *Seal*, it is similar to that of other Carnivora.

In the *Solipeds*, the Ossa Ilia are large, and the Ossa Ischia short. The Acetabula, as in many other Quadrupeds, correspond with the posterior third part of the length of the Ossa Innominata. The Symphysis Pubis is remarkable for its length; and, in old Animals, is frequently Anchylosed.

In the larger *Ruminants*, as the *Ox*, the Ilia are of great breadth. In the more diminutive species, they are proportionally smaller. The external surface is concave.

Among the *Belluæ*, the Pelvis of the *Pig* is similar to that of the Feræ, but the Ossa Ischia go farther back, and the Notches of the Ilia extend farther into the Bones. The *Elephant* and *Rhinoceros* have broad Ossa Ilia; the Abdominal Surface is concave, the Pelvis is of enormous size, and the Symphysis Pubis of great length.

The CETACEA have no Pelvis, except two thin flat Bones, suspended in the flesh of the back part of the Belly, and side of the Anus, and somewhat analogous to the Ossa Pubis.

The

The *Thorax* of Animals without Clavicles is commonly compressed externally, or is deeper from Spine to Sternum, than in the Human Species, especially in long-legged Animals.

The *Ribs* are present in all the individuals of this class. They vary in number in different tribes; the greater number of Mammalia possess more Ribs than are found in Man, though in a few the number is smaller.

There is also considerable variety in the form; in *Herbivorous Animals*, they are observed to be broad and thick. The *Armadillo* has the two first pairs very large in proportion to the rest. The *two-toed Ant-eater* has Ribs so broad as to overlap like the tiles of a house, and give the appearance of a coat of mail.

The number of the Ribs on each side of the Thorax of Mammiferous Animals, corresponds with that of the Dorsal Vertebræ, and can therefore be readily known by examining the preceding Table.

Sternum.—This, in the *Ourang-outang*, is broad and flat as in Man, but in other *Apes*, and in many Mammalia, it is narrow, of a roundish form, and composed of several moveable pieces, corresponding to the motions of the Spine.

In the *Bat* it is like a T, the fore part going across to be articulated with the Clavicles.

The *Mole* has the Anterior Extremity prolonged before the Ribs, to be joined to the Clavicles under the Neck, so as to give origin to strong Muscles of the Anterior Extremities, which assist the Animal in burrowing under the ground.

The *Horse* and *Elephant* have the Sternum flattened laterally.

The *Pig* has it narrow before, but much enlarged posteriorly.

ANTERIOR EXTREMITIES.

The Anterior Extremities in Mammalia can be divided nearly as the Superior Extremities of the Human Body, though in some of the individuals of the class, they vary considerably from the corresponding parts in Man.

Most Quadrupeds want *Clavicles*, in consequence of which, the Anterior Extremities come nearer each other, and their progressive motion is rendered easier.

The *Clavicles* are found in all Quadrupeds which use their Anterior Extremities much for other purposes besides walking.

They exist in the *Ape tribe*, and there they resemble those in Man. They are present also in the *Bat*, where they are remarkable for their thickness and strength; in the *Mole*, *Shrew*, *Hedge-Hog*, *Squirrel*, *Rat*, and *Beaver*.

In the *Dog*, *Cat*, *Weasel*, *Bear*, *Otter*, *Seal*, *Hare*, there is only a *Clavicular Bone*, suspended in Flesh; these animals forming a sort of medium between the former and those that want Clavicles, such as, *Solipeds*, *Ruminants*, Belluæ, and the Cetacea.

Scapula.—This exists in all the Mammalia. It differs in

in shape from that in Man, and its form varies considerably in different Animals.

In the *Ape* and *Elephant*, the edge next the Spine is, as in Man, the longest; in most other Quadrupeds, it is the shortest.

The Coracoid Process is commonly wanting, though present in many. In the *Pig*, the Spine of the Bone is almost effaced near the Humeral Extremity; but about its middle, there is a large projecting Process.

Arm.—In all Animals, the Os Humeri is single in each Anterior Extremity, as in the Human Arm, and becomes shorter as the Metacarpus is elongated.

In Animals with a single Metacarpal Bone, the Os Humeri is deeply seated in the Fleshy parts of the Thorax. There is often a hole in a kind of Linea Aspera which projects in the Arm-Bone, and frequently a perforation in the Bone where it receives the Olecranon.

In the *Mole*, the Os Humeri is peculiar, not only for its shortness, but in being articulated by one small head to the Scapula, and by another to the Clavicle. It is altogether of such a nature as to turn the Palm outwards, for working with the Hand.

Fore-arm.—The motions of Supination and Pronation are found in the Anterior Extremity of a few Genera only, and these are chiefly for enabling the Animals to lay hold of, or search for, their food.

In *Apes*, the Bones have the same general appearance as in Man, but the Radius is the principal Bone. The *Bat* has no Ulna, or only the Rudiment of one.

In *Carnivora*, the Olecranon is extended farther back than in Man. In the *Pig*, *Elephant*, and some other Animals of similar shape, the Radius is placed entirely before the Ulna; they move on a single pulley.

In *Solipeds* and *Pecora*, the Ulna is only an Appendix of the Radius. In the latter it is anchylosed with the Radius almost its whole length. In Solipeds, there is a Furrow, with a slit on the top. Hooved Animals have the Inferior Head of the Radius compressed, and the back of the Carpus turned forward. In the Cetacea, the Radius and Ulna have a flattened form.

Hand.—The *Carpus* in *Apes* has one Bone more than in man. The Os Pisiforme is so prominent as to serve as a sort of Heel; and the same thing happens in the *Carnivora*. In the *Mole*, besides nine Bones, as in the *Monkey*, there is a *Falciform Bone*, which gives the shovel-like form to the Hand.

In *Carnivora*, the Scaphoid and Lunar Bones are joined into one piece. *Ruminants* have four Bones in the first range. Most have two in the second. *Solipeds* have four in the first range, and three in the second. In *Cetacea*, the Bones of the Carpus are flattened, and joined together in the form of a pavement.

Metacarpus.—The number of the Bones here is in general equal to that of the Fore Toes, except in *Solipeds* and *Ruminants*, where, in the former, the Metacarpal Bone consisted originally of two pieces, and, in the latter, the two Metacarpal Bones are at an early age united into one piece. In both these orders, this single piece is termed *Canon* or *Shank Bone*.

In the *Horse*, the Canon Bone has a pair of much shorter

shorter pieces, called *Styloid* or Splint Bones, firmly attached to its posterior and lateral parts; these have been considered also as Metacarpal Bones.

In the *Pig*, the Metacarpus consists of four distinct Bones.

In the *Dog*, *Horse*, *Ox*, *Sheep*, &c. where only the Toes touch the ground in supporting the Body, the Metacarpus forms the part commonly called the *Fore Leg*, the Carpus being termed the *Knee*.

Toes.—There are always from three to five Toes in *Mammalia*. All *clawed Quadrupeds* have five. *Solipeds* have one perfect, and two imperfect. *Ruminants* have two perfect, and two imperfect.

Each perfect Finger or Toe has three Bones, except the Thumb or Great Toe, which has never more than two.

The Metacarpus and first Phalanx are more curved towards the Palm, and the Phalanx on which the Nails are placed is always rounded, and more pointed than in Man.

The *Ape tribe* have the Thumb separate, and opposed to the other Fingers, but always shorter than in the Human Species. In this respect, the Human Hand is superior to that of every other Animal.

The different parts of the Hand are found in several individuals of this class, but less complete than in the Hand of the Human Body, the great superiority of which, arises from the size and strength of the Thumb, which can oppose the Fingers in the various offices the Hand has to perform.

In the *Bat tribe*, the Phalanges of the Fingers, be-

tween which the Membranes of the Wings are extended, are much elongated, especially the last, which have no Nails; but the Thumb is short, and furnished with a Claw, in form of a hook, by which the Animal can suspend itself when in a state of rest.

The *Glires* have the Thumb short, but otherwise perfect.

In the *Feræ*, the Toe, resembling the Human Thumb, is on the same plane with the other Toes; of course they have not the power of grasping any thing. In some, as the Bear, Badger, &c. it is almost equal in length. In the *Dog*, *Cat*, &c. it is shorter.

Each of the Bones of the last Phalanx in the *Lion*, *Tiger*, *Cat*, &c. is remarkable in having the fore part in form of a hook, which receives the Claw as in a sheath. The back part forms two Processes, to which the Muscles are attached, that can at once extend the Claw and bend the Phalanx.

In *Ruminants*, the single Metacarpal Bone supports the two Toes which form the part termed *Cloven Foot*. Several species have besides two little Bones, frequently covered with Nails, which represent two other Toes; but these are so short as not to touch the ground. There is here also a small Bone, which forms a Rudiment of the Thumb.

In *Solipeds*, the only vestige of the lateral Toes, are the two sharp-pointed *Styloid Bones*, on each side of the Canon Bone. The three Bones of the single Toe are termed *Pastern*, *Coronet*, and *Coffin Bones*; the last of which is received into the Hoof. At the back part of the Pastern are also two *Sesamoid Bones*. The Cof-

fin

fin Bone has a piece connected to it, under the name of *Shuttle Bone.*

The *Elephant* has five perfect Toes, but they are almost entirely concealed by the Skin of the Foot.

In the web-footed Quadrupeds, as the *Otter* and *Seal*, and in the Pectoral Fins of the *Cetacea*, the Bones analogous to those of the Hand, are in a flattened form, and, in the latter kind of Animals, are often in a state of Cartilage. The Anterior Extremities of the Seal, &c. form a sort of medium between those of other Mammalia and the Cetacea, being more confined than the former, but less so than the latter.

POSTERIOR EXTREMITIES.

Os Femoris.—In every class of Animals, the Os Femoris, like the Os Humeri, is single. It varies in length according to that of the Metatarsus. In most Quadrupeds it is so short, that it scarcely projects beyond the Abdomen, in consequence of which the Leg, properly so called, is commonly termed the *Thigh.*

The Cervix of the Thigh-bone here is remarkably short, but the Great Trochanter rises considerably above the head of the Bone. In some Animals, as the *Horse*, there is an *Unciform Process.* This, in the *Rhinoceros*, forms, with the Trochanter Major, a Foramen between them and the body of the Bone.

The *Leg Bones* are nearly as in Man, but the Tibia, in general, is considerably longer than the Os Femoris. In the *Ape tribe*, they are more nearly equal. In some

of this family, the Bones of the Leg and Thigh are much shorter than those of the Fore-arm and Humerus.

In the *Rat* and *Mole*, the Tibia and Fibula form one continued Bone for a considerable part of their length.

In the *Rodentia*, the Fibula is placed entirely behind the Tibia; also in the Dog, where the two Bones are attached through their whole length.

In the *Horse*, the Fibula is only a Rudiment anchylosed by age to the upper part of the Tibia. In *Ruminants*, it is wanting.

In the *Pig* and *Elephant*, the Fibula is anchylosed through its whole length to the Tibia.

Tarsus.—In Quadrupeds with Toes, the Tarsal Bones have a near resemblance to those in Man; they differ only in a few particular circumstances. In *Monkeys*, strictly so called, the Os Calcis generally wants the Tuberosity of the Heel, at its Posterior Extremity; and the Tarsus is articulated with the Leg Bones, in such an oblique manner, that the Foot rests more on its outer edge than on the Sole. In some of the *Lemurs*, the Os Calcis and Os Scaphoides are so long, as to give the Foot the appearance of a Hand.

In *Carnivora*, the Ginglymus at the lower end of the Tibia is more complete than in Man. The Heel is longer, and quite straight, in those that walk only on the Toes. In the *Mole*, the Tibia alone is articulated with the Tarsus. *Rodentia* have the Os Calcis much elongated. In some Animals, as the *Opossum* and *Beaver*, the Tarsus has a *Supernumerary Bone* on its inner side.

Solipeds

Solipeds have only two Cuneiform Bones in the Tarsus. In *Ruminants*, the Scaphoid and Cuboid Bones are united together, except in the *Camel*, which has them distinct.

The Tarsus of the *three-toed Sloth* has only four Bones, viz. the Os Calcis, the Astragalus, and two Cuneiform Bones. The Astragalus is articulated with the Fibula, with the Os Calcis, and the Great Cuneiform Bone, in such a manner, that the Foot possesses only lateral motion, but which is perfectly adapted to the requisite purposes of embracing and climbing the Trunks and Branches of Trees.

Metatarsus.—The structure of the Metatarsus is in general the same with that of the Metacarpus. The *Ape tribe* have the Metatarsal Bone of the Great Toe only about half the length of the others, but it can be readily separated to some distance from them. *Solipeds* and *Ruminants* have a single Metatarsal or Canon Bone of the Hind Leg, which, in the former Genus, and sometimes in the latter, has a small Styloid Bone on each side.

Toes.—In *Apes*, the smaller Toes are longer than in Man. The Phalanges are much of the same nature with the corresponding parts of the Anterior Extremities.

The Great Toe is shorter than the rest, but the Metatarsal Bone can move like the Thumb, in opposing the other Toes when the Animal is climbing trees, &c. The same thing takes place in the Genus *Opossum*, but this structure is only in the Posterior Extremity.

In *Carnivora* in general, the Great Toe is united with,

and

and parallel to the rest. The *Bear*, *Badger*, and *Mole*, have it nearly equal to the length of the other Toes. In the *Dog*, *Cat*, and *Hare*, it is almost obliterated.

The *Elephant* has five perfect Toes, the *Pig* four.

Solipeds have one perfect Toe, and two imperfect, articulated with a single Metatarsal Bone. *Ruminants* have two perfect Toes, and two small ones, attached to the under part of a Metatarsal Bone. *Cetacea* have no Bones in the Tail Fins, which correspond to the Posterior Extremities of Quadrupeds.

In *clawed Animals*, the Phalanges of the Toes of the four Extremities are the parts on which the Animal is supported. In *hooved Animals*, no part touches the ground but the last Phalanx. In the *Bear*, *Hedgehog*, &c. a larger portion of the Foot touches the ground than in any other Quadruped. The Os Calcis comes near it; but in none of the Mammalia except Man does the Foot rest completely on the ground.

OF

OF THE MUSCLES.

THE *Muscles* must vary in the different orders of Mammalia according to the nature of the Skeleton. The degree of resemblance between the Muscles of the Animals of this class, and those of Man, may be known in a general way, by comparing the Skeleton of any particular Animal with that of the Human Body.

The Muscles in the *Ape* tribe bear the greatest resemblance to those in Man; but a striking difference appears in the former, on account of the smallness of the Fleshy part of their Hips, and in the diminutive appearance in the Calfs of their Legs.

Muscles of the Integuments.—In Mammiferous Animals, with the exception of a few, as the *Hog tribe*, there is a thin Fleshy expansion, termed *Panniculus Carnosus*, lying directly under the Skin. It covers the greater part of the Trunk of the Body, and also a portion of the Neck, Head, and upper part of the Thighs. Its Fibres unite below the Axilla, where they are inserted by one or two tendons, along with the Tendon of the great Pectoral Muscle, under the Head of the Humerus. It acts partly upon the Anterior Extremity,

but

but serves chiefly for the motions of the Skin. By it also, the Animal can make the Hair stand on end, particularly in the Neck.

The Skin of the *Hedge-hog* possesses a curious complex Muscle. It is of an oval form, and is placed along the Back, adhering closely to the Skin, and even to the roots of the Prickles or Spines. It sends slips to the Face, to the under parts of the Throat, Thorax, and Abdomen, and to the lateral parts of the Tail. By the contraction of these slips, assisted by the Flexor Muscles of the Head and Trunk of the Body, the Animal, when in danger, can coil itself up as in a Sac. It returns to its ordinary posture, by acting with the middle part of the Cutaneous Muscle, the other parts becoming relaxed, so as to leave the lower parts of the Body, the Hands, and the Feet free.

In the *Armadillo*, the Cutaneous Muscle, though less strong and complex, is also of such a nature as to allow the Body to be coiled up.

The Panniculus Carnosus exists also in the *Dolphin*.

Muscles of the Eye and Ear.—They will be noticed afterwards in the description of these Organs.

Muscles of the Nose and Mouth.—In *Apes*, the Nose is affected by a continuation of the Panniculus Carnosus. In Carnivora, as the *Dog*, the Nose is moved by the Levator Labii Superioris Alæque Nasi, that covers the Cheek, and the Depressor Alæ Nasi, which is small.

In Animals with projecting moveable Snouts, as the *Bear* and the *Mole*, the Cartilaginous Tube of the Nose is moveable in every direction on the end of the Osseous

Osseous Snout, by several Muscles. In the *Mole* and the *Hog*, they extend from the side of the Head and Bones of the Upper Jaw, and terminate by Tendons which are placed round the Nasal Tube. They serve for raising or depressing the Snout; or, by the action of the Muscles of the same side, it is turned laterally. The Snout in both of these Animals is surrounded by Annular Fibres, which are a continuation of the Orbicular Muscle of the Lips.

In *Solipeds*, besides Muscles analogous to the Levator Labii Superioris Alæque Nasi in Man, there are others arising from the Bones in the neighbourhood, and fixed to the Nostrils, of which four are described by Authors, viz. the *Pyramidalis*, belonging also to the Mouth; the *Transversalis*, which runs parallel to the Orbicularis Oris; the *Musculus Brevis*, which goes from the Nasal Bone to the False Naris; and the *Musculus Maxillaris*, serving for the dilation and contraction of the Naris.

Ruminants have the Muscles of the Nose less complicated: two arise from the Os Maxillare, and go to the upper, outer, and under edges of the Nostril.

The *Proboscis* of the *Elephant* has, between the External Integuments and the two Tubes which it contains, a thick Fleshy Layer, composed of two sets of small Muscles, or fasciculated Fibres; an inner one, running in a transverse, and an outer one, in a longitudinal direction. Of the Transverse Fasciculi, some run across the Proboscis, others in a radiated, and some in an oblique direction, between the surface of the Tubes and the inner part of the longitudinal Fibres. These form the inner part or body of the Organ. The

radiated

radiated and oblique Fibres approximate the Skin and the Tubes without contracting the cavity of the latter. The others, which go across the Proboscis, contract both the surface of the Organ and the Canals it contains. They can at the same time elongate the whole of the Organ, or a particular part only. The longitudinal Fasciculi form four large Muscles, which occupy all the outer part of the Organ. They are divided by Tendinous Intersections, and take their origin behind from the Bones of the Face. They serve to shorten the whole or a part of it, and give that extraordinary power which the Animal possesses of moving the Snout in every direction.

The Muscles of the Mouth of Quadrupeds must vary according to the shape of the Lips. In the *Dog*, the Mouth is moved by six pairs of Muscles and a Sphincter, viz. the Levator and Depressor Labii Superioris Alæque Nasi, the former of which is principally used in snarling; the Levator and Depressor Labii Inferioris, the Buccinator, and Masseter. The five first are nearly as in Man; the last has many of its Fibres spread out upon the Buccinator, in consequence of which they can forcibly raise the corners of the Mouth.

The Mouth of the *Horse* is moved by the following Muscles, viz. the Levator Labii Superioris, which in this Animal is used in neighing, and in the *Ass* for braying; a Muscle termed *Pyramidalis*, analogous to the Levator Labii Superioris and Levator Anguli Oris, arising from the fore part of the Superior Maxillary Bone at the Zygoma, and fixed to the Ala Nasi and Corner of the Mouth; another Levator, termed *Maxillaris*,

illaris, coming from the Forehead, and going obliquely outwards by two slips to the wing of the Nose and angle of the Mouth; the large *Zygomatic Muscle;* the *Buccinator;* the Levator Anguli Oris, termed *Molaris*, spread out upon the Buccinator; the Depressor Labii Inferioris; two small Muscles, termed *Middle Superior* and *Middle Inferior* of the Lips; and the *Orbicularis.*

Muscles of the Lower Jaw.—The Temporal Muscle in the *Ape* kind differs but little from that in the Human Body. In the *Feræ*, it is much thicker and stronger in proportion to the size of the Animal, corresponding with the hard substances the Teeth have to divide. In the *Glires*, the Muscle is less extensive than in the former; but in some of the *Rat* kind, the Muscle is so extensive, as almost to meet its fellow on the opposite side of the Head.

The Masseter agrees with the Temporal Muscle in being thick and strong, corresponding with the force required in bringing the Jaws together.

Besides the Muscles mentioned above, and which are common to Quadrupeds in general, many of the *Glires*, as the *Squirrel*, *Rat*, &c. have a fifth pair, for assisting in the elevation of the Under Jaw. Each takes its origin from the Upper Jaw, near the Infra-Orbitar Foramen, and is fixed to the Lower Jaw near the Pterygoideus Externus.

The Pterygoid Muscles only vary in size and length, and in the obliquity of their Fibres, corresponding with the size and form of the Jaw.

The Digastric, in the *Ape* tribe only, possesses two distinct Fleshy Bellies, and a middle Tendon, perforating

rating the Stylo-hyoid Muscle. Among the *Feræ*, there is only one Belly, and it runs forward to be fixed to the Base of the Lower Jaw, most frequently a little beyond the Masseter.

Among the *Rodentia*, it is continued to the Chin, to which it is fixed. In other Mammalia, it varies a little in its general appearance and attachment, according to the nature of the Jaw, and of the motions it has to perform.

Muscles about the Neck and Throat.—The place of the Platysma Myoides is supplied by the Panniculus Carnosus.

The Sterno-mastoideus is nearly as in Man, but is blended in various ways with the Trapezius and Deltoides.

The Sterno-hyoid and Sterno-thyroid Muscles arise in common from the Cartilaginous Extremity of the first Rib; but in the *Lion*, the origin of the former extends in the Thorax, along the three anterior Bones of the Sternum.

In the *Seal*, where the Anterior Extremity of the Sternum is slender, the Sterno-hyoideus arises from the first Rib.

The Stylo-hyoideus is perforated by the Digastricus in the *Ape*, but not in other Quadrupeds.

In Quadrupeds possessing a Styloid Process, there is a Muscle peculiar to them, termed *Stylo-mastoideus*, which arises from the outer surface of the Mastoid Process, and is fixed to the Styloid, which it raises outwards. Some Carnivora have also a small Muscle filling the space between the Cornua of the Os Hyoides.

The

The other Muscles connected with the Os Hyoides vary in different Animals, according to the shape of the Bone.

Muscles situated on the Inferior and Lateral Parts of the Abdomen.—The Abdominal Muscles differ from those in Man chiefly in regard to their proportional length. This difference is most remarkable in the Recti of Carnivora, which often extend as far as the Anterior Extremity of the Sternum. In such cases the Pyramidales are frequently wanting.

Muscles of the Parts of Generation,—see Articles *Parts of Generation.*

Muscles situated within the Cavity of the Abdomen.—The Fleshy part of the Diaphragm is generally broader in proportion, and it has more extensive motion than in Man, not being so firmly united to the Pericardium. The Quadratus Lumborum, Psoas Parvus, Psoas Magnus, and Iliacus Internus, are present in most Quadrupeds. They differ only in proportion, which depends upon the number of the Vertebræ of the Loins, and the length of the Os Ilium.

Muscles situated upon the Inferior and Lateral Parts of the Thorax.—The Pectoralis Major is for the most part proportionally larger than in Man, and is divided into several portions, giving in some measure the appearance of as many distinct Muscles. In *Carnivora*, the insertion of the Muscles extends as far as the under part of the Humerus. The Pectoralis Minor in Carnivorous Animals and Ruminants, is wanting; but in the *Horse*, its place is supplied by another Muscle, though this is so con-

nected with the Pectoralis Major, as to go partly to the Humerus.

The Subclavius, in the *Ape* tribe, is as in Man; in Mammalia without Clavicles, it is wanting.

The Serratus Magnus is more extensive in the Inferior Mammalia than in Man, being attached not only to the Ribs, but to the Transverse Processes of the Cervical Vertebræ.

Muscles situated between the Ribs, and within the Thorax.—The Intercostal and Sterno-costal Muscles are nearly as in Man, only the latter Muscle is generally larger, and may therefore act more powerfully upon the Ribs.

Muscles situated on the Inferior part of the Vertebræ of the Neck.—The Muscles on the inferior part of the Vertebræ of the Neck are not materially different from the corresponding Muscles of the Human Body, but generally have their Fleshy Bellies proportionally larger and more distinct.

Muscles of the Spine and Superior Parts of the Trunk in general.—In *Apes*, the Muscles of the Spine differ only in the strength of their Tendons. In the other Mammalia, they differ in the number of their attachments, which depends upon that of the Vertebræ. The motions of the Os Coccygis are much more visible in the rest of Mammalia than in Man. The Tail, which is merely an elongation of it, can in general move readily in every direction; may even be turned upon its own axis, or rolled spirally.

The Muscles of the Os Coccygis in Animals with prehensile Tails are remarkably numerous, to assist them

them in climbing, as in the *Monkeys* and *Opossums*, or in springing, as in the *Kanguroo*.

The Spine of the *Horse* is remarkable on account of the great breadth of the Ligamentum Nuchæ, which assists in supporting the Head. There is likewise a peculiarity of this substance in the *Mole*, where a large portion of it is ossified, being employed in throwing up the earth.

The small Muscles of the Head exist in Quadrupeds as well as in Man. In general, the Complexus has one continued Fleshy Belly, though, in the *Feræ*, there are Tendinous Intersections through its whole length. The Splenius is inserted into the Ligamentum Nuchæ in such Animals as have this Ligament considerably raised above the Vertebræ.

MUSCLES OF THE ANTERIOR EXTREMITIES.

Muscles of the Shoulder.—The Serratus Magnus, Pectoralis Minor, and Subclavius, have been already taken notice of.

In the *Ape*, the Trapezius resembles that in Man; but in other Quadrupeds, it is complicated with the Sterno-mastoid and Deltoid Muscles, and in some with the Levator Scapulæ, which has great variety, in the number and insertions of its Tendon, in different Quadrupeds.

In the *Rabbit*, a peculiar Muscle arises from the fore part of the Spine of the Scapula, and is inserted into the Clavicle. The Rhomboid in *Apes* is extended as

far as the Occiput. The Occipital portion of it, in *Carnivora*, forms a Muscle termed *Levator Scapulæ Magnus*. The Omo-hyoideus is wanting in Animals which have no Clavicle nor Coracoid Process, as in *Dogs*. The Subclavius is present in Animals with, but absent in those without Clavicles.

Muscles of the Arm.—All the Muscles of the Humerus exist here, but with some variety. The Pectoralis Major, as already mentioned, is generally more Fleshy, and divided into different portions. The Latissimus Dorsi differs little. The Supra-spinatus, Infra-spinatus, Subscapularis, Teres Major, and Teres Minor, differ chiefly in their proportions, corresponding with the form of the Scapula. The Coraco-brachialis exists in Quadrupeds in general; but in those wanting the Coracoid Process, it arises from the upper edge of the Scapula. *Monkeys* have the Coraco-brachialis divided into two portions, one of which extends along the whole length of the Humerus.

Muscles of the Fore-Arm.—The Biceps and Brachialis Internus are similar in *Monkeys* to those in Man, except that the Brachialis arises almost as high as the Neck of the Humerus.

In many Quadrupeds, as the *Dog*, *Cat*, *Horse*, &c. the Muscle corresponding to the Biceps has only one Head, which has no connection with the Coraco-Brachialis.

In *Monkeys*, the Triceps has an additional portion, which arises from the Tendons of the Latissimus Dorsi and Teres Major. In many other Animals, this fourth portion is found. In Quadrupeds in general, the Extensors

tensors are complicated, and of great strength, corresponding with the purposes required in their progressive motion. In the *Cetacea*, where the two Bones of the Fore-arm are not moveable upon the Humerus, the Triceps is wanting. But the Anconeus is present in all the Animals mentioned above.

Muscles of the Hand.—*Apes* have Supinators similar to those in Man. The *Dog* and *Cat* have the Supinator Brevis, but the Longus is wanting. They are both wanting in *Solipeds*, *Ruminants*, and *Bellucæ*. The Pronators are the same in *Apes* and *Carnivora* as in Man. *Solipeds* and *Ruminants* have no Pronators. The number of Flexors and Extensors of the Hand is nearly the same in *Monkeys*, and other clawed Quadrupeds, as in Man. In Quadrupeds with a Canon Bone, the Extensor Carpi Radialis is inserted into the fore part of the Base of that Bone, which it extends; and the Flexor Carpi Radialis is inserted into the back part of the Base. The Flexor Ulnaris and Extensor Ulnaris are fixed to the Bone that corresponds to the Os Pisiforme. The three last Muscles are Flexors in these Animals.

Muscles of the Fingers.—The Extensor Digitorum Communis, in Quadrupeds with four Fingers or Toes independent of the Thumb, has four Tendons, in *Ruminants* two, in *Solipeds* only one. The Extensor Proprius Digiti Minimi, in *Monkeys*, sends Tendons to the fifth and fourth Fingers; in *Dogs* and *Bears*, to the fifth, fourth, and middle Fingers. In *Solipeds*, there are two Extensors fixed to the first Phalanx of the Toe.

In *Ruminants*, this Muscle extends the Outer Toe, and the Extensor Indicis the Inner Toe.

The Extensor Indicis Proprius, or Indicator, in *Monkeys*, sends a Tendon to the fore, and another to the middle Finger. In *Dogs* and *Cats*, it is situated as in Man. In *Solipeds* and *Ruminants*, it is wanting.

The Extensor Ossis Metacarpi Pollicis is similar, in *Apes* and many other clawed Animals, to that in Man. In *Solipeds* and *Ruminants*, it is fixed to the base of the Metacarpal Bone, and forms the Oblique Extensor of the Canon Bone.

The Extensor Primi Internodii is present in *Apes*, *Dogs*, *Cats*, &c. The Extensor Secundi Internodii Pollicis is indistinct in *Apes*, and wanting in the *Dog*, *Cat*, &c. In *Solipeds* and *Ruminants*, the two last-named Muscles are wanting.

The Flexors of the Thumb, in clawed Quadrupeds, are somewhat similar to those in Man. In *Ruminants*, the Flexor Sublimis and Flexor Profundus of the Fingers send each two Tendons to the Toes. In *Solipeds*, there are two similar Muscles, but only a single Tendon to each, the one also perforating the other.

MUSCLES OF THE POSTERIOR EXTREMITIES.

Muscles of the Thigh.—In the generality of Quadrupeds, the Gluteus Medius and Minimus are large.

In the *Horse*, the Muscle corresponding to the Maximus in Man is the smallest of the three, and is almost Aponeurotic.

Aponeurotic. The Medius in that Animal is the Muscle principally used in kicking.

In the *Bear*, however, the Gluteus Maximus is so large, compared with the other Muscles, as to enable the Animal frequently to put itself into the upright posture.

The Iliacus Internus and Psoas Magnus are generally in proportion much longer than in Man, corresponding with the greater length of the Pelvis. The Pectineus, in the *Dog*, is peculiar for extending to the bottom of the Os Femoris.

In the *Cetacea*, the Muscles of the Thigh are entirely wanting.

Muscles of the Leg.—In *Apes*, the Muscles here are similar to those in Man, except that corresponding to the Biceps, which has only a single Head. In the *Rodentia* and *Carnivora*, the Extensors of the Knee are smaller than in Man, while the Flexors are stronger, corresponding with their purposes of walking. The Sartorius and Gracilis form the anterior edge of the Thigh. In all Quadrupeds, the short head of the Muscle analogous to the Biceps is wanting; but the single head not only covers a great part of the outer side of the Thigh, and is inserted into the Fibula, but gives Fibres to the whole length of the Fascia Lata, and performs the office of an Extensor of the Thigh. In all Quadrupeds, the Gracilis is large; the Semimembranosus and Semitendinosus, which are never wanting, are inserted so much farther down the Tibia than in Man, as to keep the Limb in a state of semi exion. This is found to be a principal cause in preventing Quadrupeds from walking in an

erect attitude. The other Muscles are nearly as in Man.

Muscles of the Foot.—The Gastrocnemius is always present, but the Soleus is smaller than in Man, and is remarkably slender in *Solipeds* and *Ruminants*. In *Monkeys*, the Plantaris is continued over the Os Calcis, to the Aponeurosis Plantaris. The Tibialis Anticus, in Animals which have no Great Toe, as the *Dog* and *Rabbit*, is inserted into the first of their Toes. In *Solipeds* and *Ruminants*, it is inserted into the Base of the Canon Bone. The Tibialis Posticus, in Animals destitute of a Great Toe, is inserted into the first Toe. It is wanting in Quadrupeds with Canon Bones. The Peroneus Longus, in the *Ape* kind, is peculiar for drawing the Great Toe towards the other Toes. In Animals without a Great Toe, it is inserted into the Metatarsal Bone of the first Toe. In *Ruminants*, it crosses over the Joint of the Canon Bone, to be inserted into the first Os Cuneiforme. The Peroneus Brevis and Tertius, in clawed Animals, are as in Man. The *Horse* has but one Peroneus. In *Ruminants*, the Peroneus Brevis is wanting.

Muscles of the Toes.—*Monkeys* have two Extensors of the small Toes; but, besides an Extensor Pollicis, there is an Abductor Longus Pollicis, which is peculiar to this tribe of Animals. Other digitated Animals have the same number as in the Human Body. The Extensor Pollicis is wanting in Animals destitute of a Great Toe, as the *Dog* and *Rabbit*. In the *Solipeds* and *Ruminants*, the Fleshy Fibres arise from the Canon Bone, and are inserted into the Tendon of the Extensor

sor Longus, of course supplying the place of the Extensor Digitorum Brevis.

In *Ruminants*, there is an Extensor Proprius analogous to the Extensor Pollicis; but in *Solipeds*, it is wanting.

In *Monkeys*, the Aponeurosis of the Sole, continued from the Plantaris, must affect the Metatarsal Bones, into which it is inserted. The long and short Flexors of the Toes are confusedly connected to each other, and to the Bones of the Foot and Toes. The Massa Carnea is attached not only to the Flexor Longus Digitorum, but to the Flexor Longus Pollicis. In other Quadrupeds, the Flexor Brevis Digitorum is wanting, but its place is supplied by the Plantaris, which is proportionally strong, and has its Tendons perforated by those of the Flexor Longus, the number of which is equal to the number of the Toes.

Though the Great Toe is wanting in these Animals, they have a Muscle analogous to the Flexor Longus Pollicis, the Tendon of which is united to that of the Flexor Profundus.

OF

OF THE COMMON INTEGUMENTS.

THE Integuments in Mammalia consist of the same number of Layers as in Man; but these vary not only in different Species, but in different parts of the same individual.

The *Cuticle* is more or less dry, according to the element in which the Animal lives, being like horn in those that live in the Air, and more of a Mucilaginous nature in such as inhabit the Water. In general it is uniform in its texture, but is often marked with lines corresponding with inequalities of the Cutis Vera. In particular parts of some Animals, as in *Apes* and *Baboons*, in the parts on which they sit, it is remarkably thick, while in the points of their Fingers it is thin and delicate. In some, as the *Elephant*, it forms a horny covering. In some, it is detached from the Skin in the form of scales; in others, it comes off at the same season with the Hairs. In the *Cetacea*, it is remarkably smooth, being always covered with an oily matter, which defends it from the water in which it is constantly immersed.

The *Corpus Mucosum* varies in thickness in different Animals,

Animals, and sometimes in different parts of the same individual. In the *Cetacea*, it is thicker than in any other Animal. The colour of this substance is also very variable. In some *Apes*, it is white on the Cheeks; in others, it is of a violet or carmine colour on the Nose and Buttocks. On the Belly of the *Whale*, it is of a silver white. A connexion also is observed to subsist between the colour of this substance and that of the Palate and Iris.

The *Cutis* is more variable in its thickness than the Cuticle. In the Wing of the *Bat*, it is remarkably thin. In most of the *Belluæ*, as the *Elephant* and *Rhinoceros*, it is of great thickness, but much more so on the Back than the Belly. In these Animals, it is deeply fissured. The Cuticle, here also very thick, follows the fissures to their bottom.

The *Nervous Papillæ* of the Skin are nearly of a similar nature in all the Mammalia to those in Man, and are also most distinct in parts most susceptible of touch. Their figures vary considerably, but their structure is nearly the same, as may be seen by macerating them for some time in water. They are very apparent in the Snout of the *Mole*, *Hog*, *Elephant*, &c. and on the Fingers of the *Monkey* tribe. They have a thread-like form on the Paws of the *Bear*, and some of the other *digitated Animals*. They have an elegant appearance at the *Teats* of the *Balena*, or true Whale; and are very distinct on the Tongue of the *Solipeds* and *Ruminants*, and in the Wings of the *Bat*.

A *sixth sense* has of late been ascribed to the Nervous Papillæ in the Skin of the *Bat*, which is found to prevent

vent the Animal from coming against external objects, even when the Eyes, Ears, and Nose are shut. This is considered to be partly owing to the Nerves which are so plentifully dispersed between the Integuments of the Wings, and is imagined to be something similar to that sensation by which a blind person discerns, by the Hands and Face, his approach to a wall, or to the door of a house, &c. before he touches them, and merely by the shock given to the air.

The *Cellular Substance* in Mammalia is, as in Man, commonly filled with Fat, the consistence of which varies according to the Species, and the state of the Body. In *Ruminants*, it is of a firm consistence, and forms the Tallow. In the *Pig*, it is thicker and more uniform, and has the name of *Lard*. In the *Cetacea*, where it forms the *Blubber*, it is still thicker than in the *Hog*, but is so fluid, that on a cut being made into the Skin, and without any pressure being applied, it runs in the form of Oil. In this last tribe of Animals, it renders the Body specifically lighter, while, at the same time, it prevents the coldness of the water from affecting the Blood, which is found to be about the heat of the rest of the Animals of this class.

The surface of the Skin of Quadrupeds is lubricated, like that of the Human Body, by an *unctuous matter*, which defends it from the action of the surrounding element, and which, in the *Dog* kind, must supply the want of sweat, that excretion, in these Animals, in some measure passing off, or at least its want being supplied, by a free discharge from the Salivary Glands. In many, as the *Horse*, a *lubricating liquor* is produced,

duced, which covers the Skin, and extends along the Hairs; or a *greasy matter* is discharged from visible Follicles on certain parts, as in the Axillæ and Knees of the Animal just mentioned. *Glandular Follicles* are in some collected into masses, and appear in certain parts of the Body, as in the Groins.

The secretions from the Skin, in some of the Mammalia, have *peculiar smells*, by which one Animal can follow the track of another, or the *Dog* even trace the footsteps of his master.

Under the Common Integuments is the *Panniculus Carnosus*, which has already been taken notice of in the description of the Muscles.

All Quadrupeds have *Hairs* more or less numerous, or something of a similar nature, to protect them from the effects of the weather, or from external injury, or to serve as ornament. They are commonly in greater abundance on the upper, than the under parts of the Body, and, as in Man, they are implanted in the true Skin, and sometimes go as deep as the Panniculus Carnosus.

The form of the Hair is commonly cylindrical, as in the *Horse*, but sometimes is flat, as in the Toes of the *Ornithorrynchus* and common *Porcupine*, Whiskers of the *Seal*, and Tail of the *Hippopotamus*; or they are curled and waving, as in many *Ruminants*.

The texture is affected by climate and manner of life. They are long and stiff in northern regions, as in the *Hog* of Siberia, and *Sheep* of Iceland; fine and silky in southern parts, as in the *Dog* of Malta, *Cat*, *Rabbit*, and

and *Goat* of Angola; thin, or almost wanting, as in the *Dog* of Guinea, and *Sheep* of Africa.

The colour of the Hair is for the most part nearly the same with that of the Corpus Mucosum; but the colour is observed to reside under the Cuticular Covering, and not in the Pith or Medulla. Some of the larger Bristles, as the Whiskers of the *Cat*, have a small Canal internally, while the Prickles of the *Hedge-hog*, and Quills of the *Porcupine*, are furrowed on the surface, and are filled with a white substance internally.

In some Animals, as the *Sheep*, the Skin is covered with Wool in place of Hairs; in the *Martin*, *Ermine*, &c. with a silky stuff, which forms the Furs; or in the *Pig*, with Bristles; or in the *Hedge-hog*, with Spines or Quills; or in the *Armadillo*, with hard Plates laid like tiles on a roof, &c. Animals are commonly born with Hairs upon them, though in some they are not observed till a certain period of life, and then only on certain parts of the Body. The Hairs in Mammalia have nearly the same component parts, and grow in the same manner, as in Man.

The *Horns* are found chiefly on the Heads of *Ruminants*, though, on particular parts of the Body, in many other Animals. They are commonly formed on Processes of the Frontal Bone, and grow from the base at an early period of life. The Skin of the part which, by its protrusion, is afterwards to form the Horn, becomes callous, then gradually changes into Horn.

In some, as the *Ox*, the Horns are round; in others, as

as the *Sheep*, they are flat, and they form different curvatures according to the kind. Between the Process of Bone and the Horn covering it, a soft Vascular Substance is interposed, which, while it nourishes the outside of the Bone, produces the Horn in successive Layers, sent off upon the internal surface. As the Animal advances in life, Furrows extend across the root of the Horn, from which, by experience, the age of the Animal can nearly be known. The Horn of the *Rhinoceros* only differs from that of *Ruminants*, in being situated over the Bones of the Nose, in appearing to take its origin from the Skin, and in having no Osseous matter within.

The colour of the Horns, as of the Hair, depends upon that of the Corpus Mucosum. In their consistence they are solid, insensible, and of a Fibrous texture; the Fibres bearing a considerable analogy to the Hairs, as may be more distinctly seen in the Horn of the *Rhinoceros*. They are more or less transparent according to their thinness. When artificially softened by hot water, &c. they may be bent in any direction, and moulded into any form.

The *Antler* of the *Stag* differs from Horn, in growing from its extremity, and not from its base; in being covered, at a certain period, with Hairs; and in being deciduous. It is a real Process of Bone, appearing, when fully grown, a continuation of the Os Frontis, and is covered, during the time of its growth, with a Periosteum and a hairy Skin, which is very Vascular; the Vessels passing through an Osseous circle at the root

root of the Antler. The growth is commonly finished before the end of the third month.

When it is completely formed, it loses its covering of Skin and Periosteum, in consequence of the Vessels at its root being obstructed, and remains afterwards quite bare; and no distinction can now be observed, but an irregular projection of a circular form at its base.

When it drops from the Head, the Integuments close over the Bone with which it was connected, till the period of its renewal returns, when a Process projects, and forms the succeeding Antler, which is always found to be longer than the preceding one. It is also observed, that the Branches of the Carotid Artery, which supply this substance, are dilated during its growth, but return to their former dimensions when it has acquired its full size.

The *Nails* and *Claws* cover the last Phalanx of the Toes of Quadrupeds, and are of the same nature, and formed after the same manner, as Horns. They grow from the base to which the Integuments are fixed, and commonly cover the upper part of the Toes; but in some, as the *Squirrel*, *Rat*, &c. they entirely surround them. They belong to Quadrupeds in general, and are orginally formed before the birth of the Animal. Their colour, as in the Horns, depends upon that of the Corpus Mucosum.

They serve for rubbing, scraping, and for catching the prey, and, in general, for protecting the extremities of the Toes. They have no sensibility but at their roots. They are wanting in those Animals which do not use the Toes for walking, or for laying hold of the food.

In

In such Animals as frequently dive or swim, the Toes are inclosed in Membranes. In the *Cetacea*, they are concealed under the Skin, and form the Fins.

All *Ruminants*, and many of the *Belluæ*, have two Toes inclosed in triangular Hooves, forming a mould on which they walk. *Solipeds* have but one Toe, the last Bone of which is inclosed in a semicircular Hoof, which supports them in walking. This is composed of a horny covering, similar in its structure and formation to the Hooves of *Ruminants*; but it incloses the whole Bone. The internal surface is formed into numerous Laminæ, which have intermediate Layers of Vascular matter for their nourishment. In the inferior part of the Hoof, there is a soft matter full of Nerves, and very sensible when punctured.

Besides the parts mentioned above, there are others connected with the Common Integuments, destined for the secretions of peculiar fluids. These occur in certain Genera and Species belonging to particular classes of Animals.

In the Temple of the *Elephant* is a *Gland*, from which a duct runs downwards and forwards, and terminates half way between the Eye and the Ear; through this, in both sexes, but more especially in the Male, a brownish liquor is discharged upon the Skin at rutting-time.

In the *Deer*, *Antelope*, and *Hare*, are Membranous Sacs, with Follicles opening into them, placed in a Suborbitar Fossa of the superior Maxillary Bone. From these a Viscid, Adipose, dark Fluid is discharged through

a clift in the Skin. This liquor was formerly supposed to have some relation to the Tears.

In the substance of the Prepuce of the Glans of the Penis and Clitoris, in many of the *Glires* and *Carnivora*, as the *Rat*, *Lion*, *Civet*, &c. are two sets of Glands, termed *Preputial*, one consisting of simple Follicles, the other of Conglomerate Glands. Each sends out a Duct, which discharges a Sebaceous matter, to defend the parts near them. In the Prepuce of the *Beaver* are similar Glands, which furnish the *Castor*. They form a mass, that has a bag near it which contains this substance, and opens at each side of the chink common to the Anus and Penis. In the male *Musk Goat*, (Moschus Moscifer), are parts similar, and similarly situated, to those of the Castor. They are of an oval form, and are full of Follicles, which separate the Musk.

In the *Hare*, and the greater part of *Ruminants*, are *Glands* under the Skin of the Groin, and therefore termed *Inguinal*, which secrete a Sebaceous fœtid substance, and send it into Cavities from which it is discharged by an orifice at each side of the Prepuce.

In many of the *Glires*, but especially in Land and Amphibious *Carnivora*, as the *Badger*, *Civet*, *Pole-cat*, *Dog*, *Fox*, *Lion*, &c. peculiar *Glands* and *Bags* are found near the outer end of the Rectum, and therefore called *Anal*. They are commonly of a spherical shape, and have a single orifice frequently ending at the side of the Anus. They secrete a matter of various colours, but commonly yellow or brown, of a strong disagreeable smell. In the *Badger*, *Pole-cat*, and *Fox*, the smell

smell is remarkably strong; and some of the *Weasel* tribe in America, as the *Skunk* and *Squash*, are observed, upon being pursued, to pour out the contents of these Bags so profusely, that their followers cannot approach them.

The matter secreted in these Bags may be excrementitious in some Animals; but in others, it appears to lubricate the Skin, and defend it from being injured by the Fœces.

The *Badger*, *Opossum*, and other *Marsupial Animals*, have *Pouches* on the Abdomen, lined with fine Hair, and discharging from their surface secretions of a Sebaceous nature, which, when recent, have a disagreeable odour, but are found, after being dried, like the Scent Bags in many other Animals, to acquire an agreeable musky smell.

Over the Sacrum of the *Aper Moscifer*, or *Mexican Hog*, there is a *Gland* termed *Dorsal*, some inches in length, and lobulated, from which a Duct opens on the Skin, and pours out a liquor which also has a musky smell.

In the Feet of several *Ruminants*, especially in *Sheep*, are Glandular Cavities, lined with Hair, and sending out an Excretory Duct, which opens at the junction of the Hooves.

OF THE BRAIN.

THE Brain in Mammalia completely fills the Cranium, and has nearly the same parts as in the Human Body; but there are certain peculiarities which distinguish the Brain of all other Animals from that of Man. These consist chiefly in its being much smaller in proportion to the Body, and also to the Cerebellum and Spinal Marrow, but more particularly to the Nerves arising from it. To this last circumstance there are no exceptions, though there are several to the others. Some of the *Ape* and *Mouse* kind equal Man in the proportion of the size of the Brain, and certain Birds surpass him; but, according to SOEMMERRING and ELBE, the size of the Brain, to the Nerves arising from it, bears an exact ratio to the faculties of the Animal's Mind; and though, in some small Animals, the Brain is proportionally larger to the size of the Body than in Man, yet all, even the *Monkey* tribe, are far inferior to him in respect to the proportion between the Brain and Nerves.

It is difficult to ascertain the exact proportion the Brain bears to the rest of the Body, on account of the different

rent states of fatness and leanness of the Animal; but, taking things in a very general way, it is found that small Animals have the Brain largest in proportion.

The largest Brain SOEMMERRING found in the *Horse* weighed 1 lb. 4 oz. while the smallest in Man was 2 lb. 5½ oz.; yet the Nerves in the former were ten times larger than those in the latter.

DR MONRO found the Brain in the *Ox* only one-fourth the weight of that of the Human Brain, while the weight of the Body of the former was six times greater than that of the latter; or, the Human Brain is twenty-four times greater in proportion to the weight of the Body, than that of the *Ox*.

In *Man*, at different times of life, its weight varies from a 22d in a young person, to a 35th of the Body in a Subject advanced in life.

In the *Ourang-outang*, it is a 48th; in other *Apes*, it varies from a 22d to upwards of a 100th; in the *Mouse*, it is a 41st; in the *Rat*, a 76th; in the *Hare*, a 228th; in the *Mole*, a 36th; in the *Dog*, from a 47th to a 305th; in the *Cat*, a 94th; in the *Bear*, a 265th; in the *Horse*, a 400th; in the *Ox*, an 860th; in the *Hog*, from a 412th to a 512th; in the *Dolphin*, from a 25th to a 102d; in the *Porpoise*, a 91st.

The proportion which the Cerebrum bears to that of the Cerebellum is as follows: In *Man*, as 6 to 1; in *Apes*, from as 6 to 1 to as 14 to 1; in the *Mouse*, as 2 to 1; in the *Rat*, as 3¼ to 1; in the *Hare*, as 6 to 1; in the *Mole*, as 4½ to 1; in the *Dog*, as 8 to 1; in the *Cat*, as 6 to 1; in the *Horse*, as 7 to 1; in the *Ox*, as 9 to 1; in the *Sheep*, as 5 to 1.

The proportional breadth of the Brain to that of the Medulla Oblongata, is, with few exceptions, greater in Man than in other Mammalia. In *Man*, it is as 7 to 1; in *Apes*, from as 4 to 1 to as 5 to 1; in the *Dog*, as 11 to 6; in the *Cat*, as 11 to 4; in the *Horse*, as 21 to 8; in the *Ox*, as 13 to 5; in the *Deer*, as 5 to 2; in the *Dolphin*, as 13 to 1.

The Falx of the Dura Mater, in Mammalia, is smaller in proportion than in Man; the Hemispheres being less in danger of injuring each other. It is of different breadths in different Animals. In a few individuals of the class, as the *Ornithorrynchus* and *Porpoise*, it is partly Osseous. The Tentorium in Quadrupeds is proportionally broader than in Man; and in many, particularly the *Carnivora*, it contains in its substance a plate of Bone. In the *Cat* and *Bear* kind, this plate is in one piece; in the *Horse*, *Dog*, and *Seal*, in three. The Osseous Tentorium is commonly considered as obviating the effects of concussion, though it is found in some Animals of slow, as well as in those of quick motion. The Falx Minor is wanting in Quadrupeds. The other two Membranes of the Brain are similar to those in the Human Species.

The form of the Brain varies in different Animals. In the *Ape* tribe, it is oval, as in Man; in *Carnivora*, and some others, as the *Hare* and *Rabbit*, it is narrower anteriorly; others have the Cerebrum almost round. In the *Dolphin*, it is remarkable, in being twice as broad from one side to the other, as from before backwards.

The

The Lobes of the Brain, particularly the Lateral, are not so prominent in other Animals as in Man, though there is considerable variety here among different individuals. In the *Ape*, there are Posterior Lobes, and these lie over the Cerebellum, as in the Human Body; but in other true Quadrupeds, the Posterior Lobes, strictly so called, are wanting; the Cerebellum lying exposed behind the Cerebrum. In the *Dolphin*, the Cerebellum is covered by the Cerebrum.

The circumvolutions of the Brain are not so deep in other Mammalia as in Man, and they are generally less numerous. In the *Ape*, they are much fewer. In the *Rodentia*, as the *Mouse*, &c. there are, in general, no distinctly marked convolutions; though they are numerous in *Carnivora*, *Solipeds*, and *Ruminants*.

In all Mammalia, the Cerebellum is marked nearly as in Man, with Transverse Fissures, which, in *Carnivora*, *Solipeds*, and *Ruminants*, divide it into Lobules, forming Convolutions somewhat as in the Cerebrum; but these vary much in different Animals. The middle Lobes of it are proportionally larger than in the corresponding parts of the Human Body.

The Cortical and Medullary parts of the Brain are similar to those in Man. The Corpus Callosum, Corpora Striata, and Fornix, vary only a little in their breadth, the last frequently covering a considerable portion of the Optic Thalami.

The Lateral Ventricles have no Digital Cavities, in consequence of the absence of the Posterior Lobes. The Cornua Ammonis are, in general, larger in proportion, but they are not so prominent on the surface.

In the *Horse*, *Ox*, *Sheep*, &c. the third Ventricle forms a sort of circular passage, which surrounds the Commissura Mollis of the Optic Thalami. The fourth Ventricle has nothing remarkable about it; the Arbor Vitæ, in the substance of the Cerebellum, has a considerable resemblance to that in the Human Brain.

The Tubercula Quadrigemina are larger, hence better named *Nates* and *Testes* in the Quadruped, especially in *Herbivora*, than in Man, though they are more nearly of the same size in the *Ape*. The Nates are Cortical, and the Testes Medullary externally, as in Man. In *Carnivorous* Animals, the Testes are generally larger than the Nates. In the *Dolphin*, they are triple the size. In *Herbivora*, the Nates, on the contrary, are much larger than the Testes, and are of a round form. The Pineal Gland, in Quadrupeds, is similar to that in Man, but is generally more conical and pointed. The Acervulus Cerebri, so frequently occurring in, or near, the Pineal Gland in the Human Brain, is seldom met with here. It has been seen in some of the *Pecora*, as the *Fallow Deer* and *Goat*.

The inequalities at the Base of the Brain are much less considerable than in Man. The Tuber Annulare is less prominent. In *Carnivora*, there are two Corpora Albicantia; in *Herbivora*, there is only one of these bodies. The Corpora Pyramidalia are considerably longer than in the Human Species.

Of the Cerebral Nerves.

There is nothing very particular in the origins of the Cerebral Nerves within the Cranium, excepting the Olfactory. These, in the *Ape* tribe only, resemble those in Man. In other Quadrupeds, they form two large Eminences, termed *Processus Mammillares*, which are chiefly of a Cineritious nature, and fill the Fossa of the Ethmoid Bone. They are remarkable for their size in Herbivorous Animals. Each contains a Cavity, which communicates with the anterior part of the Lateral Ventricle of that side by a small passage; of course, there are six Ventricles in proper Quadrupeds.

This circumstance gave rise to the ancient opinion, of the first pair of Nerves conducting the Pituita from the Brain to the Nose.

The number of the Nerves from the Brain is the same as in Man. They vary chiefly according to the form and extent of the parts on which they are dispersed.

From the First Pair, numerous Fibrillæ come off, to be distributed upon the different parts in the upper portion of the Nose. In the *Sheep*, there is also a Branch, arising, within the Cranium, from the upper part of the Trunk of the Nerve. In the *Dolphin* and *Porpoise*, the Olfactory Nerve is entirely wanting.

The Optic Nerves are conjoined as in Man, but they appear to be still more intimately incorporated. In large Animals, the Fibrillæ composing these Nerves are so separated from each other by the Pia Mater, that after

after the Medullary Substance is dissolved by maceration, the remaining parts, by being inflated, appear like so many distinct Canals.

The Third Pair goes through a hole appropriated to it, when there is no Sphenoid Fissure, either singly, or in company with some of the other Nerves of the Eye, and is distributed as in Man.

The Fourth, also, is as in Man.

The Fifth, as in the Human Species, is also divided into three Branches, and these are larger or smaller, according to the form of the different parts of the Face. In Carnivorous Animals, as the *Tiger*, the second and third portions of this Nerve appear to be uncommonly large.

The Sixth Pair, as in the Human Body, is bathed in Blood; and, while in the Cavernous Sinus, it is connected by one, two, or more Branches with the Great Sympathetic.

The Seventh, as in Man, divides into the Portio Dura and Portio Mollis. The former differs according to the form and extent of the different parts of the Face upon which it is dispersed. The Portio Mollis, as in Man, is entirely spent in the Labyrinth of the Ear.

The Eighth and Ninth are dispersed nearly as in Man.

The Great Sympathetic Nerve has nearly the same connexion in the Cranium with the Fifth and Sixth Pairs,—the same connexion in its course with the Nerves near it,—and forms the same kind of Ganglia, as in Man; only varying a little in the number of Filaments sent off, or in the form of the Ganglia.

SPINAL

SPINAL MARROW AND VERTEBRAL NERVES.

The Spinal Marrow is covered by the same Membranes, and divided into two Lateral Cords in the same manner, as in the Human Body. The division into two Lateral Portions is still more distinctly marked than in Man. The number of the Nerves coming off from the Spinal Marrow is equal to that of the holes between the Vertebræ; and they arise in a similar manner as in the Human Subject.

The Cervical Nerves are seven in number on each side in Mammalia in general, besides the Occipital and Accessory Nerves. The size and extent of the Branches of these Nerves vary according to the nature of the parts which they supply. The Brachial Plexus is produced by the three last Nerves of the Neck, and first of the Back. They consist, as in Man, of a number of large Trunks, variously disposed, according to the shape and size of the anterior extremity. The Diaphragmatic Nerve is quite similar to that in Man.

The Dorsal and Lumbar differ only in number from those in the Human Body, and they may be known by attending to the number of the Vertebræ.

Of the Pelvic and Caudal Nerves, the former is as in Man, the latter go from the Vertebral Canal, by the Foramina between the first pieces of the Caudal Vertebræ, to be dispersed upon parts at the root of the Tail, and upon the continuation of that substance.

The Nerves of the Posterior or Abdominal Extremities form a Plexus, of which the Cords, and their distribution, are nearly as in the Human Species.

OF

OF THE EYE.

ALL Mammalia have two Eyes. They are largest in proportion in small Animals, excepting in such as live much under ground, as the *Mole* and *Shrew*, in which they are quite diminutive.

In the *Ape* kind, their direction is forward as in Man, but they are closer together. In other Quadrupeds, they are placed laterally, and proportionally more distant from each other.

In Man, and in the *Ape* tribe, the axis and diameter are nearly equal to each other. In the greater number of Quadrupeds, the axis is rather less than the diameter. In the *Cetacea*, it is found to be nearly as two to three.

Eye-lids are common to all the Animals of the class, but the under one, in most Quadrupeds, wants Cilia. In most of the *Ape* tribe, in the *Elephant*, &c. they are present in both Eye-lids. The Sebaceous Follicles are very distinct in the larger Mammalia, as the *Ox*, &c. The greater number of Quadrupeds have a third Eye-lid, termed *Membrana Nictitans*, or *Palpebra Tertia* vel *Interna*. It is of a thick substance, and crescentic form,

form, is placed at the inner corner of the Eye, and varies in size as circumstances may require. In many, it is only a partial covering. In the *Lion* and *Cat* tribe, *Elephant*, *Seal*, &c. it goes over the whole anterior part of the Eye. In Man and *Apes*, there is only a Rudiment of it. In the *Cetacea*, it is wanting.

The Caruncula Lacrymalis is observed in some, as the hooved Animals; but in others it appears to be wanting.

The Lacrymal Gland exists in almost all the Animals of the class, and has nearly the same situation as in Man. In some, as the *Ruminants*, it is divided into Lobes. In the *Hare* and *Rabbit*, it is so large as to cover a great part of the Eye. The Ducts of this Gland are numerous, and, in larger Quadrupeds, can be readily seen passing through the upper Eye-lid.

Besides the Lacrymal Gland, several Quadrupeds have an additional substance, termed *Glandula Harderi*. It exists in some of the *Glires*, in the *Carnivora*, *Ruminants*, and *Belluæ*. In *Ruminants*, it is situated at the inner angle, and discharges a whitish humour, which passes by an orifice under the Palpebra Tertia.

The Puncta Lacrymalia are in general the same as in Man. In the *Hare*, *Rabbit*, and some others, in place of Puncta, there is a slit under the Palpebra Tertia, opening into the Lacrymal Duct. In *Sheep*, the Puncta join into a long Nasal Duct, which terminates near the bottom of the Nose.

Some of the *Ruminants*, as the *Deer* and *Antelope*, are remarkable for the Larmiers, or Fossæ Lacrymales, which are small Cavities upon the Cheek under the Eye-lids,

lids, and communicate by a Groove with the inner angle of the Eye.

In the *Elephant*, the Lacrymal Organs have not been found; and in the *Cetacea*, as in most Animals living constantly in the water, they are wanting.

The Tunica Conjunctiva agrees, in general, with that in Man, varying only a little in colour over the Tunica Sclerotica.

The Cornea, in Quadrupeds, is not quite circular, being somewhat wider in a transverse than in a longitudinal direction. It varies a little in convexity in different Animals, and also in its proportion with respect to the Sclerotica. In all it is composed, as in Man, of transparent thin Membranes, closely united.

The Iris exhibits great variety in colour in different Animals. Each Species, in the wild state, is observed to have a fixed colour: but this varies in domestic Animals, though less than in the Human Species. These variations are found to correspond, in some measure, with the colour of the Hair; and in party-coloured Animals, a mixture of colours has been observed in the Iris. A Fibrous structure appears in the Iris of some Animals, as the *Ox*, which DR MONRO thinks, if Muscular, may affect the Pupil. BLUMENBACH has not been able to discover true Muscular Fibres in the Iris even of the *Elephant* and *Whale*.

The motions of the Iris in the whole Animals of this class are involuntary. The form and size of the Pupil correspond with the Animal's manner of life. In the *Ape* kind, and many *Carnivora*, it is round as in Man. In *Solipeds*, *Ruminants*, and *Cetacea*, it is transversely oblong.

oblong. In the *Cat* kind, it forms an oval, placed in a vertical direction, and, in a strong light, is contracted almost to a line. The size of the Pupil is in proportion to the quantity of light wanted. Night-watching Animals, as the *Cat* tribe, have it contracted through the day, and dilated through the night, to receive a sufficient quantity of light. In the Fœtus, at an early period of Gestation, the Pupil is covered with a Membrana Pupillaris, as in the Human Species.

The Sclerotis, in most of the Mammalia, corresponds in texture with that in Man, and, as in the Human Eye, is thinner at the anterior than posterior part. In the *Seal* it is thick and firm, except at its middle, where it is so thin and flexible, as to influence what are termed the *Internal Changes* of the Eye. In a *Whale* of ordinary size, where the Eye is only equal to the bulk of an Orange, the Sclerotis is fully an inch thick at its back part, but thinner and more yielding anteriorly, which may in some measure answer the same purpose with the flexibility in the middle of the Sclerotica of the *Seal*.

The Cornea, in the *Whale*, is received into a Groove of the Sclerotic; but in the other animals of this class, there is considerable variety in the attachment of these Coats; though in all, it appears they can be separated from each other by maceration.

The Choroid Coat and Ciliary Processes exist in all the Animals of the class; and both of these parts, as well as the back of the Iris, are generally lined with a Pigment, which, in the *Ape* kind, is brown or black, as in Man. The Ciliary Processes, and their Vascularity, are very conspicuous in some of the larger Animals

mals of this class, as the *Leopard*, *Horse*, *Ox*, *Whale*, &c.

In some of the *Glires*, as the *Hare* and *Rabbit*, and in the *Carnivora*, *Solipeds*, *Ruminants*, *Bellua*, and the *Cetacea*, there is a real Pigmentum Nigrum at the fore part of the Eye; but at the Back and Temporal Side, the colour is brilliant, and is termed *Tapetum Lucidum*. This is wanting, however, over the entrance of the Optic Nerve. In the *Horse*, *Goat*, and *Deer*, the Tapetum is of a silver blue, changing into violet. In the *Ox*, it is green, changing into a sky blue; in the *Sheep*, green; in the *Cat* kind, *Bear*, and *Dolphin*, pale yellow; in the *Badger*, *Dog*, and *Fox*, it is blue, changing into white. In general, the paint is brightest in night-watching Animals, the brightness reflecting more light upon the Retina. Wherever the Pigmentum exists in the Eye, it is of a black colour where it lines the fore part of the Choroides and back of the Iris.

In some *entirely* white Animals, as the *White Rabbit*, *White Mouse*, &c. there is no paint upon the inner side of the Eye; in such cases, there is a great degree of redness, owing to the Blood-vessels of the Choroides shining through the Retina and Humours; where, however, there is the least spot of a dark colour, this is not always observed.

The Optic Nerve commonly passes through a Cribriform part in the bottom of the Eye, and has in general the same appearance, and same kind of termination, as in the Human Subject. In some Animals, as the *Hare* and *Rabbit*, the Nerve goes, without dividing, through the Sclerotis and Choroides, and forms a sort of Cup, from

from the edges of which the Retina arises, having Medullary Fibres in it, and these running chiefly in a transverse direction.

The Foramen Centrale, or spot seen in the Retina near the axis of the Human Eye, has been observed in several of the *Ape* tribe, where the Eyes are placed nearly in the same direction as in Man.

The Lens, in all Quadrupeds, is divided into two spherical segments; the posterior is generally the more convex of the two. In Man, the Lens is found to be proportionally the least and flattest. Of all other Mammalia, BLUMENBACH found it proportionally the greatest in the *Opossum*, and the least in the *Whale*. In some Quadrupeds, it is of a much rounder form than in the Human Body. In the *Cetacea*, it is nearly spherical. The proportion of the axis to the diameter has been observed to be, in Man and the *Ape* tribe, as 1 to 2; in the *Dog*, as 7 to 9; in the *Horse*, as 2 to 3; in the *Ox*, as 5 to 8; and in the *Whale*, as 13 to 15. The other Humours of the Eye have nothing particular in them. The proportions of the three Humours, the Aqueous, Crystalline, and Vitreous, measured on the axis of the Eye, are in Man, 5, 4, 15; in the *Dog*, 5, 8, 8; in the *Horse*, 9, 16, 18; in the *Ox*, 5, 14, 18.

Of the Muscles of the Eye.—Those in the *Ape* kind are the same as in Man. In other Quadrupeds, the Eye has a peculiar Muscle, termed *Suspensorius*, which may assist the others according to the direction of its Fibres. It arises, with the straight Muscles, from the edge of the Foramen Opticum, and, running between

these and the Ball, is fixed to the Sclerotis a little behind the insertion of the Recti Muscles. In the *Horse* and *Ruminants*, it is in the form of a Funnel; but in the greater part of *Carnivora*, and in the *Cetacea*, it forms four distinct Muscles. In the *Rhinoceros*, it is divided into two parts; but, besides these, MR THOMAS of London has discovered, that this Animal has four Tendinous Processes, which arise from the inner side of the Sclerotis, at the bottom of the Eye. These spread out and join anteriorly, to form a kind of Muscular Membrane, that is inserted into the Choroides at its widest part, and is supposed to be connected with the internal changes of the Eye.

In all Mammalia, the Globe of the Eye is surrounded with Fat, which answers the same purpose as in the Human Body.

OF

OF THE EAR.

THE Organ of Hearing exists in all the Animals of the class, and the External Ear in most of them; but there are several individuals in which the latter is deficient, as those which live much under ground, as the *Mole*, or in the water, as the *Ornithorrynchus*, most *Seals*, the *Walrus*, *Manati*, and the *Cetacea*. The essential parts are in general as in Man, varying chiefly in form, and in all adapted to their manner of life. The Lobe is wanting in all the Quadrupeds. An Auricle, resembling that in Man, is only found in some of the *Ape* kind, though a Concha, or External Ear, exists in Quadrupeds in general; but even in the *Ourang-outang*, as well as in other *Apes*, it is more pointed than in Man.

The External Ear varies much in its general appearance, direction, and composition. Timid, and also nocturnal Animals, as the *Hare*, *Deer*, *Bat*, &c. are observed by Naturalists to have large Ears, to add to their acuteness of hearing, and enable them to guard against beasts of prey. The Concha is found to be turned backward in those that fly, as the *Hare*, and

forward in such as pursue, as the *Lion*, &c. Or in some, the superior part of the Concha is turned down, as in the *Spaniel*, *Sheep*, *Hog*, *Elephant*, &c. which enables them to hear sounds from below. Pendant Ears are considered by some Naturalists as marks of slavery.

In the *Bat*, the Concha is so constructed, as to prevent the Air from rushing violently in while the Animal is flying. The External Ear, in Quadrupeds, is more conical, and more uniform internally, than in Man.

In all the class, excepting some of the *Ape* tribe, the outer bar of the Ear, or Helix, is wanting, the part being thin, and sharp on the edges; and instead of an Antihelix, there is a transverse eminence, situated deep in the Ear. There is a Tragus and Antitragus, the latter of which, in some Animals, as the *Shrew*, serves as an Operculum to the Ear.

In Animals with very long and moveable Ears, the Muscles are much more numerous than in Man. In the *Dog*, *Horse*, *Sheep*, &c. they are from a dozen to twenty in number to each Ear. Some arise from the Head, and are fixed to the part at the root of the Concha of the Ear, termed *Scutum*; others come likewise from the Head, and are inserted into the Concha or Meatus Externus; some pass from the Scutum to the Concha, and some from one part of the Concha to another. By means of these Muscles, the Animal can commonly move the Ear in every direction, or turn it upon its own axis, without moving the Head.

All Adult Quadrupeds have the Meatus Externus osseous at its inner part; but it varies in length, width, and direction, in different Species. In some, it is cylindrical;

lindrical; in others, flattened; in *Apes*, it is nearly as in Man; in *Carnivora* and *Ruminants*, it passes directly inwards; in some, as the *Otter* and *Pole-cat*, it goes in a retrograde direction; in the *Rodentia*, it is directed downwards; in the *Mole*, where it is quite flat, it has the Membrana Tympani laid over it like a roof; in the *Elephant* and *Horse*, it goes downwards and backwards.

In some Animals which dive in the water, it is provided with a Valve, as in the case of the *Water Shrew*, and some *Whales*. In the *Cetacea*, the Osseous Canal, like the External Auricle, is wanting; in place of which there is a Cartilaginous Tube, which begins by an orifice proportionally very minute, on the surface of the Skin, and leads in a winding direction through the Fat, till it terminates at the Membrana Tympani. In the *Ornithorrynchus*, also, the Meatus is observed to be long and tortuous.

The Membrana Tympani, the Tympanum, and the Eustachian Tube, are found to be common to all Mammalia; and the Membrane of the Tympanum appears to be concave externally in all the individuals of the class, the *Cetacea* not excepted. Its structure nearly resembles that in the Human Body. It is fixed in a case of Bone, which is commonly open above, and is somewhat of an oval form, with the long diameter placed in a vertical, or in an oblique direction, though it varies in this last respect considerably in different Animals.

The Tympanum differs in size, form, and situation. It is oval in some, round or hemispherical in others,

and in several it is angulated; or is sometimes so shallow as to be in form of a chink.

In the *Ape* tribe, there are scarcely any Mastoid Cells to communicate with the Tympanum, the Process containing these in the Human Body, being in this race of Animals almost obliterated; but, in place of Mastoid Cells, there are others which extend a considerable way into the Temporal Bone.

In the greater part of *digitated* Mammalia, instead of a Mastoid Process, there is a Bony Organ, communicating with the proper Tympanum, which, in the greater part of the *Glires* and *Carnivora*, forms a large Cavity, or *Bulla Ossea*, that makes the principal part of the Tympanum. This, in the *Dog*, *Cat*, *Lion*, *Tiger*, &c. is globose; in *Ruminants*, it is angular; in the *Bear*, it is wanting. In the *Solipeds*, *Ruminants*, *Pigs*, &c. the Cavity is divided into Cells, and there is behind this a long Process, like the Mastoid, or in some like the Styloid, but belonging to the Occipital Bone.

In some Animals, as the *Indian Hog*, *Marmot*, and *Porcupine*, the walls of the Tympanum shew vestiges of Cells; but the Cellular appearance is more distinct in the *Elephant*, where this Cavity is of great size.

The Tympanum, with its Bulla Ossea, in the *Cetacea*, is formed of a Bony Lamina, rolled on itself like a Concha; but there is no spiral Cavity in it, the substance being quite solid and hard like a rock. This has been frequently mistaken for the Labyrinth in these Animals.

The Internal Parts of the Ear, in the *Whale* tribe, are

are not connected to the Bones of the Cranium, as in other Mammalia, but are loosely attached by Ligaments.

The Eustachian Tube, in Mammalia, has nearly the same kind of structure and openings as in Man. In the *Horse*, it communicates with a large Sac placed in the lateral and posterior part of the Mouth. In the *Cetacea*, it is of great size, and terminates at the Nose or Blowing Hole, where there is a Valve to prevent the water from rushing into it when thrown out by this opening.

The Ossicula Auditus are the same in number in almost all Mammalia, but they vary much in form and size in the different Species. In some Quadrupeds, as the *Mole*, *Marmot*, and *Guinea Pig*, a Process is found, which extends from one side of the Fenestra Ovalis to the other, and passes between the Crura of the Stapes, so that, when the Stapes is removed, there appears to be two Fenestræ Ovales. In the *Whale*, that Bone has very nearly an entire Plate, instead of two Crura.

In some of the Bisulca, one or two additional Bones are occasionally found. The *Ornithorrynchus*, on the contrary, has only two Ossicula, the second of which approaches in its form to the single Bone in Birds, (see Phil. Trans. 1805.)

The Muscles of the Internal Ear of Mammiferous Animals appear to be nearly the same as in Man.

The figure and size of the Fenestra Rotunda, and Fenestra Ovalis, are found to vary considerably. In some, as the *Bear*, the Cochlear Foramen is triangular;

in others, as the *Ant-eater*, both the Foramina are oval, and nearly equal in size. In *Carnivora*, *Solipeds*, *Ruminants*, and *Cetacea*, the Cochlear Foramen is the largest; in some it is double or triple the size. In the *Hare* and *Opossum*, the Vestibular Opening is by much the largest. In all Mammalia, the two Foramina are filled, the Cochlear with Membrane, and the Vestibular with Bone.

The Labyrinth is nearly similar to that in Man, but the proportional size varies much among the different Species. As in the Human Subject, also, it is commonly hollowed out in the Pars Petrosa; but in some, as the *Bat* and *Mole*, it is visible in the Cranium without any preparation. In some it is large; in others, small. The Cochlea is almost always turbinated, and the number of turns are commonly the same in the different individuals, excepting a few, as the *Guinea Pig*, *Porcupine*, and *Indian Hog*, where there is a turn more, and the *Cetacea*, where there is a turn less, than in Man.

In most *Carnivora*, and in the *Horse*, *Hog*, and *Elephant*, the Cochlea is larger in proportion to the semicircular Canals than in Man. In *Bats*, it is remarkably large, compared with the Canals. The size of the two Canals of the Cochlea is in general nearly equal; but in some, as the *Dog*, *Horse*, and *Elephant*, the Scala Tympani is the larger. In the *Cetacea*, the semicircular Canals are proportionally so small, that by some they have been overlooked, and by others, as Dr Camper, their existence has been denied.

The

The Vessels and Nerves of the Ear are in proportion to the parts on which they are dispersed. They do not differ materially from those in the Human Body. In Mammalia, as well as in Man, the Portio Mollis passes, with the Portio Dura, into the Meatus Internus, and enters the Labyrinth by several Holes, the number and size of which vary in different Animals.

OF

OF THE NOSE.

THE Nose, in Mammalia, corresponds with that in Man, in communicating with the Fauces, and conducting the air to the Lungs; but differs from it in form and size,—in the Sinuses and Laminæ which increase the extent of the Nasal Cavity,—and in the Cartilages which cover the aperture of the Nose.

The Sinuses of the Head, all of which lead directly or indirectly into the Cavity of the Nose by small apertures, differ considerably in shape, size, and general appearance. They are peculiar to Man and Quadrupeds, and are not fully expanded till the Animal arrives at its full size.

Frontal Sinuses.—These, in some of the *Ape* tribe, are large; in others, inferior in size. Among some of the *Glires*, as the *Rat* and *Hare*, they are wanting; but in some of the *Feræ*, as the *Dog*, *Wolf*, and *Fox*, they are so large as to go from side to side of the Head, and even to occupy the greater part of the Frontal Bone. In the *Horse*, also, they extend through a large share of the Os Frontis, but, instead of communicating directly with the Nose, they lead, by a considerable opening,

opening, to the Posterior Maxillary Sinuses. Among the *Pecora*, there are scarcely any Frontal Sinuses in the *Deer*, while the *Ox* and *Sheep* have them of great extent. In the *Pig*, also, they are very extensive; but the *Elephant* has them the largest that are found in any Animal, if the Diploe, or Cells, already mentioned, can be regarded as such. They extend, in that Animal, between the Tables of the Frontal, Parietal, and Temporal Bones, as far as the Occipital Condyles. The *Rhinoceros* and *Hippopotamus* have none.

Ethmoid Cells.—In a number of Quadrupeds, these are distinct from the Superior Spongy Bones, and they are sometimes separated from the general Cavity of the Nose by a distinct partition. In the greater number of Animals, they vary considerably in their appearance from those in Man. They are sent down from the Cribriform Plate in the form of hollow Pedicles, and, extending in the Cavity of the Nose, the nearest, in proportion as they advance, unite with each other. They form little Caverns, which, as they increase in size, become less numerous, and communicate among themselves by different passages. Carnivorous Quadrupeds are found to have the greatest proportion of these Cells. The *Glires* have but few.

Sphenoidal Sinuses.—These are the smallest in proportion in Quadrupeds; many want them, but they are of great extent in the *Elephant*, though not Cellular, like the other Sinuses of this Animal.

Maxillary Sinuses.—In the *Ape* tribe, these are proportionally smaller than in Man. They are diminutive in most of the *Glires* and *Carnivora*, and, in general, where

where the Maxillary Bone does not form a Plate under the Orbit. In the *Horse*, there are two large Maxillary Sinuses on each side, the one behind the other, each opening by a separate passage into the Nose. These Sinuses are very large in *Pecora;* they are wanting in the *Hog*, but their place seems to be supplied by a Sinus in the base of the Os Malæ.

In the *Elephant*, they are divided, like the Bones of the Cranium, into numerous Cells, which communicate with each other, and terminate by a common passage in the Nose.

The Foramina in the Cribriform Plate of the Ethmoid Bone, in different Quadrupeds, are so unequal in size, that the part assumes the appearance of Fine Lace, and their number is considered to be in proportion to the acuteness of the sense of smelling. They are large and numerous in the *Elephant* and *Hind*, but abound most in Animals of the Carnivorous kind.

Ossa Spongiosa.—The Conchæ, or Ossa Spongiosa, are more convoluted in other Mammalia than in Man; which affording a larger surface for the expansion of the Membrana Pituitaria and the distribution of the Olfactory Nerves, contributes to increase the power of smell. Hence most of the *Feræ*, and the *Pecora* in general, having more complicated Ossa Spongiosa, are observed to possess greater acuteness in this sense.

In *Solipeds*, *Pecora*, and *Belluæ*, the superior or anterior Spongy Bone is formed in each side by one of the Cells of the Ethmoid Bone, which extends to the Os Spongiosum Inferius, and is placed over it like tiles on a roof. In most of these Animals, its convolutions

are

are numerous, to provide as large a surface as possible within the confined space of the Cavity of the Nose.

In *Apes*, the Ossa Spongiosa Inferiora, seu Posteriora, in some of their Species, resemble those in Man; but in others, they approach those of the *Feræ* and *Belluæ*. In all these Animals, the Lamina in each Nostril is simple at its base, but is forked at a little distance from this; each of the two Laminæ that grow from it, coiling up into two or two and a half turns, according to the Species. The Plates forming the Inferior Concha contain two Canals, one above, the other below, the principal Lamina; the inferior leading into the Posterior Nares.

The Inferior Spongy Bones are perforated by numerous Holes of different size; but in the *Pig*, the Laminæ are impervious. In *Solipeds*, the Inferior Concha is less regular than in the Animals mentioned above; instead of forking at the base, it bends first down, then up, and is attached to the Maxillary Bone.

Among the *Glires*, the *Hare*, *Squirrel*, and *Rat* kind, and in the *Feræ*, the *Dog* and *Cat* trib, the *Bear*, *Seal*, &c. have the Inferior Spongy Bone extremely complicated. The first Lamina is forked, and each Branch subdivided. The last Laminæ form a number of parallel Canals for the passage of the air, and the distribution of the Nerves.

The number of Laminæ in the Inferior Conchæ is very variable. The *Seal* and *Otter* are observed to have them in greatest abundance. Next to these come the *Dog* and *Bear*. Among the *Glires*, the *Beaver* has most, and the *Hare* least of them. In some of the *Feræ*,

Fera, as the *Lion*, there is only a double roll something like that in *Pecora*.

Cartilages.—The Cartilages of the Nose vary considerably in different Quadrupeds. Those in the *Ape* tribe differ from the analogous parts in Man chiefly in their diminutive size. The Muscles affecting the Nose, in these Animals, appear to be part of the Panniculus Carnosus. In Carnivorous Animals, as the *Dog*, in which the Nose does not project beyond the Mouth, the Cartilages also bear a considerable resemblance to those in the Human Species. In Carnivorous Animals with moveable Snouts, as the *Mole* and *Bear*, the Cartilages form a complete Tube, which is connected to the edge of the Osseous part of the Nose.

The Snout of the *Hog* bears a considerable resemblance to that of the *Mole*, but its Cartilages are shorter in proportion.

The Nose of Carnivorous Animals has distinct longitudinal Muscles, the ends of which, and the Snout itself, are covered with circular Fibres, continued from the Orbicular Muscles of the Lips, as already observed.

In *Solipeds* and *Ruminants*, the Osseous Nares are large, and have a Notch in their lateral parts. The soft portion of the Nose, connected to the Bones, forms the Nostrils, strictly so called, the edges of which, in the *Horse*, inclose a Cartilage, called *Semilunar*. The rest of the external part is merely a fold of the Skin, and forms a Cavity termed *False Naris*, which has the same common opening with the Nostril. The Muscles of the Nose are noticed in a former part of the Volume.

The Pituitary Membrane agrees in its general structure

ture with that in Man. Its surface has numerous Pores, from which a Mucus constantly exudes, to keep the parts moist.

The Blood-vessels are from similar Trunks with those in Man.

The Nerves arise from the first and fifth pairs also, as in the Human Body. The Olfactory Nerves penetrate the Ethmoid Bone by Fibrillæ, corresponding in number and size to the Foramina in the Cribriform Plate, and are dispersed upon the Mucous Membrane covering the Cells and Anterior Conchæ of this Bone, and upon the partition of the Nose. Some of these are soft and pulpy; others, as in the *Ox* and *Sheep*, can be readily traced. The Branches of the fifth pair belonging to the Nose, are from the Ophthalmic and Superior Maxillary Portions. Of the first, some minute Branches penetrate the Superior Orbitar Plate, to be dispersed upon the Membrane lining the Frontal Sinuses; others go to the Nose, re-enter the Cranium, and return to the Pituitary Membrane, as in Man. The Superior Maxillary Nerve supplies the inferior-posterior parts of the Nose, and sends Twigs to the Maxillary Sinuses much after the same manner as in the Human Species, allowance always being made for the size and form of the organ in different Animals.

Trunk and Proboscis of the Elephant.—This very singular Organ is extended into a long Fleshy substance of a conical form, fixed by its base to the Frontal and Intermaxillary Bones.

It contains two Tubes a little before its axis, which form

form the prolongations and external openings of the Nose. These are nearly cylindrical, but contracted at their extremities, particularly next the Head, where they are twice inflected upon the Intermaxillary Bones, and fixed round the Osseous Nares. This part is protected by the Cartilage of the Nose, which is of an oval form, and so much more convex in the Male than the Female, that by this it is said the sex can be distinguished.

The Tubes are covered with a strong Tendinous Membrane, and perforated by many Mucous Follicles, which open into their Cavities. They are separated from each other, and are both surrounded by a quantity of white Adipose Substance, which also extends between the different Muscles that occupy the space between the Tubes and the Skin, and which have been already described. The outer part is covered by the Common Integuments, which are lined with a Tendinous Membrane and Cellular Substance. The Proboscis serves to pump up the drink which the Animal takes in; but, according to CUVIER, the Tubes want that delicate structure internally, which is necessary for the Organ of smell; so that, in his opinion, this sense in the *Elephant* is confined to that part of the Nostrils contained in the Bones of the Head.

In the *Cetacea*, the Nares and Spiraculæ differ much from the Organ of smell in other Mammalia, being placed on the summit of the Head, and serving as passages of respiration, and for the rejection of the water which enters the mouth along with their Food. The two Osseous Nares are placed so high on the Head, that

that the Animal can breathe while the Mouth is under water. They are furnished with two semicircular fleshy Valves, which are shut by a strong Muscle.

On the upper side of the Valves are two Membranous Sacs, lined with a black Mucous Skin, which is the continuation of the Common Integuments, and covered externally by a strong Muscular Expansion that arises from the Cranium. They have a common opening externally, by a narrow chink in form of a crescent. The water taken in by the Mouth, and which, in Fishes, is thrown out at the openings of the Gills, is here prevented from being swallowed, by the contraction of the Pharynx. This elevates the Valves, and distends the Sacs, from which the fluid is forcibly discharged to a great height by the surrounding Muscular Fibres.

OF THE MOUTH AND THROAT, WITH THEIR APPENDICES.

LIPS.

THE Lips, or Fleshy moveable parts exclusive of the Jaws, are found to be peculiar to Man and Quadrupeds; the Cetaceous tribes have none.

Quadrupeds, the *Ape* tribe not excepted, have fewer Muscles in the Lips than are met with in the Human Species; of course, they have less variety in their motions. Where the Nose is prolonged into a Snout, as in the *Pig* and the *Elephant*, there is scarcely any Upper Lip; the Muscles which, in other Animals, belong to the Upper Lip, are here employed in moving the Nose.

In those which want Teeth in the Upper Jaw, the Gums are harder than in others, to compensate for this.

TONGUE.

The Tongue, in all Mammalia, is fleshy and flexible, and in the different individuals of this class, varies chiefly

chiefly in the extensibility of its fore or loose part. In some Animals, as the *Ant-eater*, *Armadillo*, and *Ornithorrynchus*, the Tongue is the longest in all the Mammalia, for seizing their prey. In the *Cetacea*, on the contrary, it is almost entirely fixed down to the Jaw; but in Quadrupeds in general, it is nearly as loose as in the Human Body. In some Animals, it serves as an Organ of taste; in others it is also employed for taking in the Food.

In most Quadrupeds, it is proportionally longer and narrower than in Man, and possesses the same kind of Papillæ, the chief difference being in their form.

In the generality of *Herbivora*, especially the *Pecora*, the Tongue is covered with a firm Cuticle, forming innumerable sharp-pointed Papillæ, directed towards the Throat. These, like so many tenter-hooks, assist in laying hold of the grass, and other kinds of Food, and serve, at the same time, to increase the Organ of taste. In some of the *Monkey* tribe, the Papillæ Maximæ are fewer in number, and differently disposed from those in Man.

In the *Feræ*, the Tongue differs little from that in the Human Body. In the *Cat* kind, besides many round and conical Papillæ, there is a horny or prickly set covering the Tongue, which render it rougher, and enable it to take a firmer hold of the prey.

The *Dog* has upon the Mouth and root of the Tongue, many Papillæ, placed obliquely backwards, which assist in preventing the Food from escaping. There is likewise, in this Animal, a Tendinous Cord, termed *Worm*, in the under part of the substance of

the Tongue, which extends as far as the point, and is inclosed in a Membranous Sheath. It is supposed to assist the Animal in lapping its drink, and is found in the *Opossum*, which drinks in a similar manner. The removal of this substance from the Tongue of the *Dog*, has long been considered as a preventive against Hydrophobia.

In *Solipeds*, the Papillæ Conicæ of the Tongue are small and compact; the Fungiform are only found in the sides of this Organ, the space behind resembling that in Man.

In most *Pecora*, as the *Ox*, &c. the Papillæ Conicæ covering the fore part of the Tongue, terminate each in a horny, flexible Filament, turned backwards, assisting, as in the Tongue of many other Animals, to lay hold of the Food. The posterior part of the Tongue is covered with Tuberculated Papillæ, which in some individuals are numerous.

Among the Cetaceous tribe, the Tongue in the *Dolphin* has no distinct Conical Papillæ.

Salivary Glands.

The Salivary Glands are found to exist in almost all Mammalia; their situation and structure being nearly as in Man. They differ only in shape, in proportional size, in colour, and in the direction of their Excretory Ducts. They are observed to be small in the *Feræ*, where there is little mastication, larger in the *Glires*, and largest of all in *Solipeds* and *Ruminants*, which grind their Food.

In

In the *Ape* kind, the Parotid Gland is remarkably large, and here the Maxillary and Sublingual open each by a distinct Duct at the Frænum Linguæ.

The Parotid exists in all Quadrupeds, except in some of the *Ant-eaters*, and the *Seal*. In the former Animals, the want is supplied by the Maxillary, which appears to be increased in size. In the *Seal*, the Sublingual is wanting, as well as the Parotid.

In the *Glires*, the Salivary Glands are of considerable size. The Parotid, in the *Rabbit*, embraces the Concha of the Ear, and extends as far as the Maxillary Gland.

The Parotid Duct, in the *Glires*, crosses the upper part of the Masseter, and perforates the Mouth opposite the last superior Molaris. The Duct of the Maxillary has no Papilla at its termination upon the side of the Frænum Linguæ.

In some of the *Porcupine Ant-eaters*, the Parotid is smaller than the Maxillary; the latter is extended in the Neck. The Sublingual is long and narrow, and the Molar Glands are united into a mass under the Buccinator.

The Salivary Glands, in the *Carnivora*, are smaller than in the *Glires*, little mastication being required by this set of Animals. The Parotid is commonly not larger than the Maxillary, and is often of an inferior size, as in the *Dog*. In this Animal, and in the *Cat*, the Parotid is of a crescentic form, and embraces the Concha of the Ear, extending as far as the Maxillary Gland. In the *Cat*, the Sublingual Gland is wanting,

and in the *Dog*, appears little more than a prolongation of the Maxillary.

The Amphibious Quadrupeds which are of the Carnivorous kind, have the Salivary Glands proportionally very small. In the *Seal*, as already noticed, there are no Parotids nor Sublinguals; but there are two Maxillaries, a great and a small, the common Duct of which opens in the ordinary place.

In *Solipeds*, the Salivary Glands are of great size, and have a lobulated appearance. In the *Horse*, the Parotids are very large, and, extending above and behind the Concha, go beyond the angle of the Jaw; the Duct runs by the under part of the Masseter, and opens upon a Papilla opposite to the Fourth Molaris of the Upper Jaw.

The Maxillary Gland extends along the side of the Larynx and Pharynx, having also a Papilla where the Duct opens at the side of the Frænum Linguæ.

The Sublingual Gland opens by many small orifices arranged along the under part of the side of the Tongue.

In *Ruminants*, also, the Salivary Glands are of great size. In the *Ox* and *Sheep*, the Parotid Duct passes by the inferior part of the Masseter, and perforates the Cheek opposite to the second and third Superior Molares.

The Maxillary is remarkably long here, and extends, as in the *Horse*, along the Larynx and Pharynx, having a Papillary Valve at its termination. The Sublingual is very long in these Animals, has a single Duct which

which runs by the side of the Inferior Maxillary, and opens upon a Papilla near the termination of the latter.

In the *Hog* among the *Belluæ*, there are two Sublinguals on each side, one anterior to the other; the posterior, which is narrow and very long, is placed on the outer side of the Maxillary, extending from the angle of the Jaw to the Anterior Sublingual, and sends out a single Duct, which terminates at a little distance from the end of the Maxillary Duct. The Anterior Gland perforates the Mouth by several openings in a range.

In the *Cetacea*, the Salivary Glands appear to be wanting.

Foramen Incisivum, vel Ductus Incisivus.—This appears in all Quadrupeds, but varies considerably in size in different Genera. In the *Ape*, it is simple below, but opens into each Nostril above. In *Carnivora*, *Solipeds*, *Ruminants*, *&c.* it is double, and forms a communication between the Mouth and each Nostril, by which fluids pass from the one cavity to the other.

THROAT.

Velum Palati.—This, in Quadrupeds, is in general similar to that in Man, only it is proportionally larger. Except in the *Ape*, it does not send out any prolongation in the form of an Uvula. In the *Elephant*, it descends under the Epiglottis, in consequence of which, liquors pumped up can be received from the Proboscis without getting into the Larynx.

In the *Cetacea*, the Velum is changed into a Canal, by which the Posterior Nares are prolonged about the pyramid of the Larynx, and their posterior part continued with the Pharynx.

Pharynx.—The Pharynx, in Mammalia in general, has nearly the same structure as in Man, but stronger on account of the necessary force required in their horizontal situation. It exists in all Vertebral Animals, but particularly in Mammalia. In many, as the *Elephant*, *Bear*, &c. there is a proper Pharyngeal Muscle, which is merely a continuation of the Muscular Coat of the Esophagus.

Bursæ Faucium.—Many Species of the *Ape*, and also of the *Marmot*, are provided with Glandular Sacs, or Cheek Pouches, termed *Bursæ Faucium*, placed behind the Palate, and serving as a temporary reservoir for the Food.

The *Camel* has this structure also, which is supposed to be intended for containing fluids to lubricate the Throat in the sandy deserts.

The *Ornithorrynchus* is also found to have Cheek Pouches.

In the *Cetacea*, the Pharynx is separated into two by the Larynx, which forms a pyramid that can rise as high as the Posterior Nares, and, by entering these, can allow the aliment to pass by each side of it to the Esophagus. There is also a particular Canal which rises from the Pharynx, and is attached to the margin of the Posterior Nares, or Blowing Holes. The circular Fibres of this Canal form a Sphincter, which, by contracting round the Pyramid, cuts off the communication

cation between the Blowing Holes, Mouth, and Pharynx.

Esophagus.—In all the class, the Esophagus is nearly cylindrical, and is continued from the Pharynx to the Stomach. It is long in all, except in the *Cetacea*. It is narrow in most, but wide in Animals which swallow voraciously.

In the generality of Quadrupeds, the Esophagus is distinguished from that in Man, by two rows of Muscular Fibres decussating each other, and running in a spiral but opposite direction. On this, Rumination is commonly explained, though the same structure exists in different Carnivorous Animals which do not ruminate, as the *Dog*, *Cat*, *Bear*, &c.; but in ruminating Animals, the Coats of the Esophagus are remarkably strong.

Many Plicæ are formed upon the inner surface of the Esophagus, which, as in Man, are most evident when it is most contracted. There are also many Follicles here, from which a Humour is plentifully supplied.

OF THE TEETH.

All Mammiferous Animals have Teeth in their Jaws, with a few exceptions, as the American *Ant-eaters*, *Scaly Lizards*, and the proper *Whales*. Besides the Teeth proper for mastication, some, as the *Dog*, *Lion*, *Tiger*, &c. have Canine Teeth, serving partly as offensive weapons, and partly to enable the Animal to lay hold of and lacerate its prey. Others, as the *Elephant*, *Hippopotamus*, and *Walrus*, have Tusks,

Tusks, serving chiefly for offensive or defensive weapons. In the *Seal* and the *Cetacea*, all the Teeth are of the same form, and answer merely the purpose of seizing the Food.

The Tusks, or Defences, of the *Elephant*, *Walrus*, and *Narwal*, are incrusted over with a substance harder than the body of the Tusk, but softer than Enamel. The Osseous substance composing these Tusks, which, in the class *Bellua* in general, and some of the *Whale* tribe, forms the Ivory, differs from that of other Teeth, in being of a harder and denser texture. The Ivory of the Elephant's Tusk is distinguished from that of all others by the Curvilinear Lozenges which appear very distinctly in the polished transverse section of a Tusk. The Ivory of this Animal is softer than that of others, and acquires a yellow hue by exposure to the air. That of the *Hippopotamus* is harder and whiter than the former, and preferred by Dentists in the making of artificial Teeth.

The most remarkable Teeth are those of the *Cape Ant-eater*, which are formed of cylinders composed of small Tubes, shut at the triturating surfaces, and, when cut transversely, appearing like a section of a Cane. The Teeth of the *Ornithorrynchus* are observed to have a similar structure.

The Bodies of Teeth, in some Animals, have a particular colour, as in the *Squirrel*, *Beaver*, &c. where they are brown anteriorly; and in several *Pecora*, where the Molares are covered by a hard black substance of a glassy appearance. In the *Ox* and *Sheep*, it is of a bronze colour.

The

The Front Teeth of the Upper Jaw are fixed in the Intermaxillary Bone, which includes also the Tusks of the *Elephant*, *Walrus*, and *Narwal*.

The number and form of the Teeth varies considerably in different Mammalia. In the *Glires*, the cutting edges of the Incisores are in the form of a Chizel.

The Teeth of some Animals, as the *Glires*, are covered with Enamel only on their anterior surface, but this is continued along the roots; hence, as the Osseous part wears down sooner than the Enamel, the Animal is still capable of gnawing hard substances.

The Teeth of the *Glires*, the Tusks of th *Elephant* and *Hippopotamus*, and others of a similar nature, are in a constant state of growth, in consequence of a Pulpy Vascular Substance within them, upon which the Osseous part of the Tooth is formed; so that the interior part of the Tooth advances to supply the portion worn down.

The Teeth of the Lower Jaw of some of the Animals of this order, as the *Squirrel*, *Rat*, and *Beaver*, are remarkable for the length of their roots, which nearly equals that of the Jaw itself, though a small portion only appears beyond the Gums. They are curved back under the roots of the Grinders, and sometimes go as far as the Coronoid Processes.

The Tusk of the *Narwal* occupies the place of an Incisor, and is almost constantly found single, the other one being either early destroyed, or lurking in the Jaw.

The Canine Teeth of the Upper Jaw, in Mammalia, are

are placed close to the Intermaxillary Bones, and differ more in the different Genera than either the Incisores or Molares. In many of the *Ape* kind, and more especially in the larger Carnivorous Animals, as the *Lion* or *Tiger*, the Canine Teeth are of great size; and in some of the *Swine* tribe, as the *Babiroussa*, they approach so near to a circle, as to render them ill adapted to the purposes to which they are applied at an early time of life.

The Molares exist in every Animal possessing Teeth, the *Narwal* excepted, which has only the long Tusk. The situation and appearance of the Grinding Teeth vary considerably in this class of Animals. In the *Feræ*, the Bodies of these Teeth are entirely covered with Enamel; and the same thing takes place in the Animal called *Mammoth*, or *Carnivorous Elephant*; while the Grinders of Quadrupeds living chiefly on vegetables, and the Incisores of the *Horse*, have plates of Enamel extending into the Substance of the Tooth, and mixed in a tortuous manner with the Osseous part. These Animals have, besides, an additional substance in their Molar Teeth, differing in its nature from the two others, being like Tartar, and termed by DR BLAKE, *Crusta Petrosa*, and by CUVIER, *Cement*. This may be readily seen either in a longitudinal or transverse section of the Tooth of a *Horse* or *Ox*, but still better in the Tooth of an *Elephant*, where it forms a large proportion of the mass.

It is then distinguished by the greater degree of yellowness and opacity of its colour, and is considered by the

the two Authors mentioned above, as being originally deposited from the Capsule which forms the Enamel. It fills the interstices on the surface of the different layers of the Enamel, and unites the layers together. It is the softest of the three component parts of the Tooth, and is more readily affected by acids and fire than the Osseous substance. It is sometimes, as in the *Cow*, *Sheep*, &c. not completely formed in the centre of the Tooth, in consequence of which Cavities are left, which become filled with extraneous matter.

The Enamel in the centre of the Incisores of the *Horse* has no Crusta Petrosa, but is filled with blackish Tartar, which extends only a short way into the Tooth, of course soon disappears, in consequence of mastication. This is termed by Farriers the filling up of the Teeth, or rather Mark of the Mouth, and forms a criterion of the Animal's age.

In many Animals which do not ruminate, as *Solipeds* and the *Elephant*, the Bodies or Crowns of the Molares have their grinding surfaces placed nearly in a horizontal direction. In *Ruminants*, their surface is somewhat oblique, the outer margin of the Upper, and the inner margin of the Under Tooth, being the most prominent.

In the greatest part of the *Feræ*, especially of the *Dog* and *Tiger* kind, where the Molares are of an irregular wedge shape, the lower ones close within the upper, and act like scissars.

All the three sets of Teeth exist in the *Ape* tribe, in *Carnivora*, in *Solipeds*, and in *Ruminants* naturally destitute

titute of horns, and in the *Belluæ*, except the *Elephant* and two-horned *Rhinoceros*; but in the Human Species only are the three sets disposed in an uninterrupted series, and the Teeth of one Jaw placed at an early age directly opposite those of the other.

The Fore Teeth of the Upper Jaw are wanting in Horned Cattle, and also the Canine, except the *Stag*, which has rudiments of the latter, and the *Musk*, which has two very long curved Tusks in the Upper Jaw.

The Canine Teeth are wanting in the *Glires*.

In *Carnivora*, and such other Quadrupeds as have the Canine longer than the other Teeth, there are vacancies in each Jaw for lodging the corresponding Canini of the opposite Jaw.

In many Quadrupeds, a large vacancy is likewise left between the Incisors and Grinders, in the middle of which, in the *Horse*, a small Tusk is found in the Male, though seldom in the Female.

The *Elephant* has Grinders in each Jaw, and two immense Tusks, termed *Defences*, in the Upper Jaw, but no other Teeth. The Tusks are placed with the concave side upward, and belong chiefly to the Male. MR CORSE SCOTT found, that in general they are so small in the Female, as not to pass the Margin of the Lip.

The *Dolphin* and *Porpoise* have small conical Teeth, all of equal size, arranged in a line in both Jaws, and serving merely for securing the Food.

The *Physeter*, or *Spermaceti Whale*, has these in the Lower Jaw only. In the *Narwal*, or *Unicorn Fish*, there

there are no other Teeth than the two long Tusks fixed in the anterior extremity of the Upper Jaw.

In the Genus *Balena*, or *Proper Whale*, the substance termed *Whale-bone*, covering the Palatine Surface of the Upper Jaw, supplies the place of Teeth. It forms numerous parallel plates, which are placed across the Jaw, and descend vertically into the Mouth. They are connected to the Jaw by a Ligamentous Substance, and send, from their opposite edges, fringes of long Fibres, which cover the whole surface of the Jaw. The composition of this substance is found to be nearly the same with that of Horn, Hair, &c. The Whale-bone is considered by Naturalists as serving to retain the Animal's prey.

In the *Ornithorrynchus Paradoxus*, there are a few Horny Teeth fixed to the Gum. There are also Teeth, of a similar nature, fixed to the root of the Tongue and top of the Throat, which may prevent the Food from escaping till properly masticated.

CHANGES OF THE TEETH.

In the *Ape* tribe, as in Man, there are no small Molares among the Deciduous Teeth, but, instead of these, two large Molares in each side of both Jaws. The Permanent Teeth, in Quadrupeds, are observed to be formed, as in Man, within Capsules; and they lie in Cavities near the roots of the Temporary Teeth, and get into the vacancies which these leave when they drop from the

the Head. The changes of the Teeth have been most attended to in the *Horse*. According to the observation of Farriers and others, the Milk Incisors appear at the beginning of the third week after birth. The four middle of these, termed the *Pincers*, fall in the 30th month, the four following in the 42d, and the four external, or Corner Teeth, in the 54th. The Permanent Corner Teeth do not grow so soon as the other Incisors; and when they appear, they scarcely project beyond the Jaw.

The hollow in the middle of the Incisors, filled with blackish Tartar, is worn off by use between the fourth and eighth year, after which it is entirely effaced. In the Corner Teeth it remains longer, in consequence of which the Animal's age can generally be known with considerable accuracy. After this period, the age is only judged of by the length of the Incisors, which are in a constant state of growth.

Of the Molares, the two first in each Jaw appear at the end of the first week, the following at the end of the third, and the small Anterior Molaris between the fifth and sixth week.

The first back Molaris appears near the end of the first year, the second near that of the second year. Between the second and third year, the first Milk Molares fall, the third drops in three years; and it is not till five or six years that the last Molaris appears. The Temporary Molares are distinguished by being longer from before backwards than the permanent set.

In *Ruminants*, there are three Milk Molares, which

are

are replaced by three others, and three Permanent Molares. The Milk Molares are distinguished from the permanent set, by being longer from before backward than in a transverse direction. The age of the *Sheep* is known by the replacing of the Incisors.

In the Asiatic *Elephant*, the Temporary Tusks drop out in twelve or thirteen months, and are succeeded by the Permanent Tusks, which continue growing through life. The Molares appear in the second week after birth; they are succeeded by the second in the second year; the third succeed in the sixth year; the fourth in the ninth year; others follow, but their epochs are not known.

The succession in the Molares of the *Elephant*, is particularly observed by MR CORSE, (Phil. Trans. 1799.) There is never more than one Grinder, and part of another, seen through the Gum. The Body of the anterior one is gradually worn away by mastication; the rest of the Tooth is carried off by absorption, the posterior Tooth coming forward to supply its place. The same Processes are found to be repeated at least eight times, and each new Grinder is larger than the former.

The first, or Milk Grinder, is composed of four separate plates, or partial Teeth, which gradually unite, and cut the Gum between the first and second week after birth. Each succeeding Grinder has an additional number of plates, the last having in all about twenty. It is observed, besides, that every new Grinder takes a year or more than the former for its formation. From

the slow manner in which the Tooth advances, a small portion of it only appears beyond the Gums, the rest of it being concealed within the Jaw. The Tooth is completed, therefore, first at its anterior part; and by the time the posterior part appears through the Gum, and is fully formed, the anterior is worn off by mastication, so that an *Elephant's* Tooth can never be obtained in a perfect state. Something of the same kind happens in the Grinders of Herbivorous Animals; when the Bodies of these are quite entire, the roots are not fully formed; and when these are complete, the Grinders are worn down.

A similar succession, but to a less degree, has been observed to take place in the *Sus Ethiopicus*, or *Wild Boar*, (Phil. Trans. 1801.)

Number

Number of the Teeth in each side of each Jaw, in a few of the different Genera of Mammalia.

GENERA.	Sup. Incisores.	Inf. Incisores.	Sup. Canini.	Inf. Canini.	Sup. Molares.	Inf. Molares.
Some Apes, -	2	2	1	1	5	5
Other Apes, -	2	2	1	1	6	6
Bat, - -	2	3	1	1	4.5	5.6
Rat, - -	1	1	0	0	3	3
Hare, - -	1	1	0	0	5	5
Mole, - -	3	4	1	1	7	6
Bear, - -	3	3	1	1	5	5
						Wolf.
Dog, Wolf, Fox, -	3	3	1	1	6	7
Cat, - -	3	3	1	1	3.4	3
Otter, - -	3	3	1	1	4.5	5.6
Solipeds, -	3	3	1	0	6	6
Camel, - -	1	3	1.2	1.2	5	5
Musk and some Deer,	0	4	1	0	6	6
Other Deer, and Ruminants with hollow horns,	0	4	0	0	6	6
Pig, - -	3	3	1	1	7	7
Elephant, - -	1	0	0	0	1.2	1.2

OF THE HEART AND BLOOD-VESSELS.

THE *Heart* has the same general appearance in all Mammalia as in the Human Body, varying only a little in some particulars.

A Pericardium belongs to every individual in the class, but, on account of the manner in which the Heart is situated, it has less connexion with the Diaphragm.

The form of the Heart in the *Ape*, *Horse*, and *Ox*, is that of an obtuse Cone; in other Quadrupeds, it is either rounded, or short and wide, or long and narrow, or notched at the point.

In the *Ourang-outang*, the Heart possesses nearly the same obliquity, and rests on the Diaphragm nearly in the same manner as in Man. The rest of the *Monkey* tribe have the point only touching the Diaphragm, and turning a little to the left. In other Quadrupeds, the Heart is placed in a longitudinal direction, and rests upon the Sternum, the point touching the Diaphragm in some, and placed at a distance from it in others. At the meeting of the Venæ Cavæ in the Right Auricle, a fleshy projection is found, termed *Tuberculum* LOWERI, which is not found in the Human Body.

The

The Eustachian Valve is present in some Quadrupeds, and wanting in others.

In Adult Quadrupeds, the Foramen Ovale is generally shut, as in Man. In the *Amphibious Mammalia*, it is commonly shut, though found open occasionally. It is also shut in the *Ornithorrynchus*, which has four Cavities to the Heart, as well as the Human Species.

The Pulmonary Ventricle, in Mammalia, is generally placed more on the right side of the Aortic Ventricle than in Man, and is so formed, that when the Heart is cut across, the section of the Left Ventricle is observed to form a circle, and the other an appendix to that circle. The proportional size of the Cavities of the Heart are found to be nearly the same as in Man; but in the *Dolphin*, the walls of the Right Ventricle are observed to be nearly as thick as those of the Left, and the Columnæ Carneæ corresponding.

The Left Ventricle differs less in Mammalia than the Right. In some, the Columnæ Carneæ are more slender than in Man; in others, less in number; and in a few, the inner side of the Ventricles is almost smooth. The Tricuspid Valve varies in the number of Columns fixing it to the sides of the Ventricle. In some, it has three, as in Man; in others, four; in some, only two. The Mitral Valve, in the *Lion*, *Ox*, and *Sheep*, forms large Monticuli, which fix it to the walls of the Ventricle.

The Semilunar Valves have nothing remarkable in them; their strength corresponds with the strength and size of the Arteries to which they belong.

The Pulmonary Artery differs from that in Man only

in the subdivision of its principal Branches, which correspond with the number of the Lobes of the Lungs.

According to the observations of CUVIER, the sides of the Pulmonary Artery, in the *Dolphin* and *Porpoise*, and probably in the other *Cetacea*, are as thick as those of the Aorta, as if the Pulmonary Circulation here differed from that in other Animals.

In a great number of the individuals of this class, the *principal Arteries* are quite similar to those in Man the Branches varying in their distribution according to the variety existing in the parts on which they are dispersed; but in others the Aorta, as in *Solipeds*, *Ruminants*, the *Hog*, &c. divides, near its origin, into two Trunks of unequal size. The smaller passes forwards, and sends off the Arteries which, in other Animals, come from the Arch of the Aorta; the other, twice as large as the former, goes backwards, and supplies the place of the Descending Aorta; hence the names of *Anterior* and *Posterior Aorta* are applied to these Arteries.

In some Animals one, and in others two, common Trunks arise from the Anterior Aorta. This Artery sends off Vessels corresponding with the Subclavians and Carotids, which, in some Animals, arise as in Man; in others, they are sent off equally in the two sides.

In *old Ruminants*, and in some other Quadrupeds, as the *Hog*, two flat Bones are frequently found at the beginning of the Aorta, known by the name of *Bone of the Heart*.

The Posterior Aorta differs from the descending Aorta in

in the Human Body, chiefly in the size and distribution of its Branches, corresponding with the division and extent of the Intestines, and the magnitude of the other Abdominal Viscera.

Of the peculiarities of the *Arteries* here, the most remarkable is that of the *Rete Mirabile*, found in the greater number of Quadrupeds, particularly among *Carnivorous Animals* and *Ruminants*. It is situated at the sides of the Sella Turcica, and consists of a division of the Internal Carotids within the Head into serpentine Branches, which afterwards uniting, form a Trunk, that divides again nearly as in the Human Body.

An uncommon division of the Arteries, also, has lately been observed in some Animals, as the *Sloth* and *Lemur*, where the Trunks separate at the top of the Os Humeri and Os Femoris into Branches, which, after descending nearly as far as the Elbow and Knee, reunite, and are then distributed in the usual way.

In some Animals, as the *Cetacea*, a considerable Plexus of convolutions is found in Arteries of particular parts of the Body, as the Intercostals, Branches from the Subclavians to the Chest, and Branches to the Spinal Marrow and Eye.

In many Animals, the common Iliacs are wanting, and there the Aorta divides into two Branches, which supply the place of External Iliacs, while a common Trunk, from the extremity of the Aorta, sends off the Sacra Media and Arteries analogous to the Internal Iliacs.

The Sacra Media, in Quadrupeds, is generally of considerable

siderable size, on account of the length of the Tail. In the *Seal*, and other Amphibious Quadrupeds, a large Ilio-lumbar Artery from the Aorta sends out the Hypogastric, the Aorta afterwards dividing into two Arteries which correspond with the Femorals.

Cetaceous Animals, destitute of a proper Pelvis, have the Aorta divided into two portions, which supply the posterior parts of the Body.

The *Veins* have the same general distribution as in Man; and in some parts, particularly in the Pelvis, they are observed to vary less than the Arteries.

The Valves of the Veins correspond in Animals in general, with few exceptions. In some Quadrupeds, as the *Horse*, DR HALLER found Valves at the origin of the Mesenteric and Hæmorrhoidal Veins, and in those of the Spleen; and in the *Dog* and *Sheep*, he met with them in the Pulmonary Veins.

The Pulmonary Veins, like their corresponding Arteries, vary in the number of their principal Branches, corresponding with that of the Lobes of the Lungs.

The most singular appearance among the Veins is found in the Foot of the *Horse*, where they form an intricate Plexus, which completely covers the surface of the Coffin Bone.

In some Animals, as the *Seal*, there is a remarkable distribution of the Veins of the Kidney, which form a Net-work, that is expanded over the surface of that Organ.

In several of the Amphibious Quadrupeds, and in the

the *Cetacea*, particular vessels are much enlarged, especially the Posterior Cava at the Liver. This is most remarkable in the *Seal*, where it is dilated into a Sac or Reservoir, which receives and retains the Blood while the Animal is under water, till it can come to the surface and respire.

OF

OF THE ABSORBENTS.

THE Absorbent System of Mammalia consists, as in Man, of *Lymphatics*, *Lacteals*, *Conglobate Glands*, and *Thoracic Duct*. The structure is the same as in the Human Body.

The Absorbents are provided with Valves, and have also two general terminations in the opposite sides of the Neck. They differ a little in the distribution of their Glands, and in the origin, course, and termination of their principal Trunk, the Thoracic Duct.

The chief parts of the Absorbent System were first discovered in Quadrupeds, the subjects for examination being more readily come at here, and the contents of the Lacteals being of the same white colour as in the Human Body.

The *Lymphatics* in Quadrupeds, as in Man, have been seen in the different parts of the Body, excepting the Brain and Spinal Marrow, in which their existence has not yet been ascertained.

In the Posterior Extremities of the larger Animals, as the *Horse*, they are easily traced; and in the Internal Viscera, in some Animals, as the *Ox*, they can be seen

seen to greater advantage than in the Human Body. In the *Sheep*, *Goat*, &c. the Lacteals run in Trunks of considerable size, and are readily detected in the *Carnivora*, as the *Dog*, by feeding the Animal with Milk, or other nourishing substances, and a few hours afterwards laying open the Abdomen.

The *Absorbent*, or *Conglobate Glands*, are fewer in number, in this class of Animals, but larger, and more collected together, than in the Human Species. The Glands of the Mesentery, in many of the Mammalia, particularly in *Carnivora*, are united into a mass, termed *Pancreas* ASELII, in consequence of the Discoverer mistaking them for that Organ.

In a few Animals, they form two groups, or in some one group, and an accessory one. In *Ruminants*, they are dispersed over the Mesentery, corresponding seemingly with the great size and length of the Intestines in Herbivorous Animals.

The connexion between the Absorbents and their Glands is observed to be less general in Quadrupeds than in Man, there being few instances where Branches reach the Thoracic Duct in the Human Body, without previously entering one or more of them; whereas, in Quadrupeds, it appears that many Absorbents go directly to the Common Trunk, without the intervention of Glands.

The internal structure of the Absorbent Glands has been observed in some of the larger Animals of the class, and in a few, as *Solipeds* and *Cetacea*, they have been found to have more of a Cellular than Vascular appearance;

pearance; but the ultimate structure here, as in Man, is not yet sufficiently ascertained.

The course and termination of the Thoracic Duct varies a little in different Animals. In some, as the *Dog*, it forms two distinct Canals; in others, as the *Sea-otter*, three or four Trunks are found.

It forms, more constantly than in Man, a Vesicular enlargement, or Receptaculum Chyli.

It makes no circuitous turn previous to its termination, the horizontal situation of Quadrupeds allowing a readier course to its contents.

There are also fewer Valves here than in Animals moving in the upright position. In the *Horse*, only a single pair is observed; while in the *Ape*, as in the Human Body, there are several Valves, to favour the passage of the Lymph and Chyle, or at least prevent their reflux.

OF

OF THE LARYNX, &c.

THE *Larynx* agrees, in its general structure, with that in Man. It differs chiefly according to the form of the Cartilages, the size and form of the Ventricles, and of certain Sacs connected with these in particular Animals.

Most of the class have a Muscle peculiar to the Epiglottis, and termed *Hyo-Epiglottideus*. It is commonly cylindrical; arises by two portions from the Base of the Anterior Cornua of the Os Hyoides, and is inserted into the middle of the Epiglottis, which it serves to raise from the Glottis.

The Epiglottis exists in Mammalia in general, with very few exceptions. It is so small in the *Bat* tribe, as to be scarcely observable. It appears to be deficient, or very small, also, in some of the *Mouse-like* Animals, as the *Glis Esculentis*, or *Rel-Mouse*.

In the *Ape* tribe the Larynx differs little from that in Man, excepting that the Ventricles are a little larger.

In the *Ourang-outang* the Ventricles of the Larynx are very large, and each divided into two by a semi-partition; above which is a Foramen, leading to a large *Sac*, discovered by DR CAMPER. These Sacs are united

ed together by Cellular Substance, but do not communicate with each other, except through the medium of the Larynx.

Many of the other *Apes* and *Baboons*, though not the whole, have also in their throats large single or double Sacs of different forms, communicating with the Larynx by one or two Foramina, between the Os Hyoides and Thyroid Cartilage. These Sacs vary in size in different individuals, and become larger as the Animal advances in years. During respiration, part of the air enters these, which in time of crying are dilated, but can afterwards collapse by the pressure of the surrounding Muscles. It is supposed by some, that the voice of these Animals is rendered proportionally weak, from part of the air getting into the Sacs.

In the *American Monkeys*, the Arytenoid Cartilages are diminutive, and turned back; the Cuneiform Cartilages, and Cellular Substance, on each side, form anteriorly a cushion, which touches its fellow; and, with the other parts of the Larynx, they compose a strait passage, turned like an *f*, which gives the flute-like voice in the *Whistling Monkeys*.

The *Howling Apes* have the anterior part of the Os Hyoides formed into a spherical cavity, by which the tones are produced that are heard at a great distance.

The principal differences in the Larynx, among the other orders of this class, are the following:

In the *Ant-eater*, which is observed to be dumb, BLUMENBACH found the Larynx entirely Osseous.

In the *Ornithorrynchus*, each of the Ventricles has only one Ligament of the Glottis.

Among

Among the *Glires*, some, as the *Porcupine*, have scarcely any vocal organs; others, as the *Rat*, have them more distinct.

In the *Feræ*, the *Bear* tribe have a singular *Larynx*. The Cuneiform Cartilages are in form of stilets, with the posterior extremities on the outside of the Arytenoid Cartilages.

The *Kangaroo* has the Arytenoid Cartilages remarkably large, but neither Ventricles nor Ligaments of the Glottis.

There is a great difference in the structure of the Larynx among the *Feræ*. The *Dog* tribe has a triangular Epiglottis, and large Cuneiform Cartilages projecting outwards, with distinctly marked vocal Ligaments.

The Ventricles of the Larynx, in these Animals, are two deep chinks, opening, not into the cavity of the Larynx, but towards the surface of the Epiglottis. The opening between the Epiglottis and Arytenoid Cartilages, is in form of an *f*.

The *Cat* has two Membranes under the Posterior Ligaments of the Glottis, which are considered as the cause of the purring noise peculiar to that Animal.

In the *Cat*, *Lion*, *Tiger*, and other Animals of this family, the Superior or Anterior Ligaments appear to be the vocal; the Ventricles are wanting.

The *Horse* has no anterior Ligaments of the Glottis, nor Ventricles strictly so called, but a Falciform Membrane, attached by its middle to the Thyroid Cartilage, while its extremities run along the external edges of the Rima Glottidis. This structure is considered as the cause of neighing in that Animal. Before the vocal Ligaments

Ligaments there is a large passage in each side, something in the form of a Ventricle, leading to a great Sac, most part of which is covered by the Thyroid and Arytenoid Muscles. Behind the Base of the Epiglottis there is also a Foramen, leading to a cavity situated under the anterior edge of the Thyroid Cartilage, but having no communication with the Lateral Sacs.

The *Ass* has the same kind of Falciform Membrane with the *Horse*, and the same number of Pouches or Sacs, but their Mouths are smaller; while the middle Pouch in the *Ass* is sensibly larger than in the *Horse*, and is the part from which the sound is considered to come in braying.

In the *Mule* produced from the *Male-Ass* and the *Mare*, or between the *Stallion* and the *She-Ass*, it appears that the Larynx is more like that of the Mother, though the voice rather resembles that of the *Ass*. The Anterior Sac in the *Mule* is larger than in the *Ass*.

Ruminants have a simple Larynx. The Arytenoid Cartilages are curved back, and form more than half of the Glottis. Their inner surfaces touch each other. There are neither Anterior Ligaments nor Ventricles in some of the individuals of this order, as the *Ox* and *Sheep*.

In some of the *Deer* kind, a passage is found at the Base of the Epiglottis, which leads to a Sac similar to that of the *Ape* tribe, and is in them situated between the Epiglottis and Thyroid Cartilage.

The *Pig* has two Bags situated above or before the Ligaments of the Glottis, which occasion the grunting of the Animal.

In the *Elephant* the Epiglottis reaches behind the Posterior

Posterior Nares, above the Velum Palati. Between the Thyroid and Arytenoid Cartilages there is a deep cavity, by which the drink passes, while the Glottis remains open, and the Animal blows the drink into the mouth, after pumping it with the Proboscis. The other parts of the Larynx have the ordinary structure.

In the *Cetacea* the Larynx forms a conical Tube, which penetrates the back-part of the Nostrils, to allow the Aliment to pass by its sides. The Tube is formed by the Arytenoid Cartilages and Epiglottis. It has neither Glottis nor vocal Ligaments, and it is generally supposed that there is no voice here, there being no Organs for the purpose. The Muscular Fibres of the Pharynx form a particular Canal, which goes to the posterior Nares, so as to intercept the communication between the Nostrils, Mouth, and Pharynx.

The Muscles of the Larynx in Quadrupeds agree in general with those in Man, varying chiefly according to the form of the Cartilages, and the different cavities belonging to them.

Thyroid Gland.—This substance belongs to Mammalia alone. In the different Genera of the class, it is proportionally smaller than in Man, but otherwise appears to be similarly situated, and to have a similar structure.

It is constantly composed of two Lateral Portions, and occasionally surrounds a part of the Trachea.

It is plentifully supplied with Blood-vessels, but is destitute of any Excretory Duct.

In the different orders of the class it varies in the form and size of its Lobes, which in some, as in Man,

are connected by a cross Slip; in others they are at a distance from each other, and without any connexion.

In the *Cetacea* MR HUNTER did not find the Thyroid Gland. CUVIER, however, detected it in the *Dolphin*, where it was divided into two portions, which were at a distance from the Larynx, and near the anterior extremity of the Sternum.

Trachea.—This presents, in general, the same structure as in the Human Body; but the number of the Bronchi varies with that of the Lobes of the Lungs.

There is great variety in the number, form, and extent of the Cartilaginous Rings of the Trachea. They approach nearer to a circle in Quadrupeds than in Man; the opening behind, therefore, is proportionally smaller.

Many of the *Glires* have rings almost complete.

In some of the *Feræ*, as the *Bear*, *Lion*, &c. they form about three-fourths of a circle.

Among other Animals, as the *Ox*, the extremities of the Cartilages meet behind in an acute angle.

In a few, as the *Lama*, *Seal*, *Lamantin*, *Dolphin*, and *Porpoise*, the Cartilages of the Trachea, and of the beginnings of the Bronchi, are observed to form a complete circle.

OF

OF THE LUNGS.

THE *Lungs* agree in form, connexion, and structure, with those in Man, but the left bears a greater proportion to the right. Here, also, they are closely applied to the walls of the Thorax.

In the Amphibious Quadrupeds and *Cetacea*, they are of a firmer texture, and have more of an elongated and flattened appearance.

For the most part there is a division into Lobes, and these are rather more deeply divided than in the Human Body. The greater number is in the Right Side.

In many, as the *Dog*, one of the Lobes goes behind the Heart, and between it and the Right Side of the Mediastinum; in consequence of which a Bulla of air is frequently observed upon opening the cavity of the Thorax, which has been mistaken by some for air confined, during life, between the Lungs and their Parietes.

Number of the Lobes of the Lungs in a few of the numerous Genera of this Class.

NAMES.	Right Side.	Left Side.
Ourangs and some Apes,	3	2
Most other Apes, -	4	2
In some, - -	4	3
Ornithorrynchus, -	4	1
Bat, - - -	1	1
Rat, - - -	4	1
Hare and Rabbit, -	4	2
Bear, - - -	4	2
Dog, - - -	4	3
Lion, - - -	4	3
Opossum, - -	1	1
Seal, - - -	2	1
Solipeds, - -	1	1
Most Ruminants, -	4	2
Pig, - - - -	4	2
Elephant, - -	1	1
Rhinoceros, - -	1	1
Porpoise, - -	1	1

OF

OF THE STOMACH.

THE shape, proportional size, and general appearance of the Stomach, vary considerably in different Mammalia. In most Carnivorous Quadrupeds, it bears a striking resemblance to that in Man. In some, however, it is long; in others, of a roundish form. In many, it is simple; in several, it is divided into different apartments.

It is termed *complicated*, when the Cavities within it have the same appearance; and *compound*, when they are of a different nature, particularly within.

The number of the Coats of the Stomach is the same as in Man, but the Muscular and inner Coat vary much in appearance. In *Carnivora*, the Muscular Coat is proportionally strong, to enable the Stomach to act more powerfully on its contents.

The inner surface, as in the Human Species, appears to be destitute of Glands, though they are observed in a few about the Cardia and Pylorus.

In the Carnivorous Quadrupeds, the Cardia and Pylorus are more directly on the extremities of the Stomach, than in the Herbivorous; in consequence of which the Food has a readier passage into the Intestines.

In *Ruminants*, these two openings are closer together, leaving a *Cul-de-Sac* on each side; from which circumstance the food is longer detained.

In the *Ape* tribe, particularly the *Orang-outang*, the Stomach varies little in its general appearance from that in Man.

There is but one Stomach in Animals destitute of Teeth, as the *Ant-eater*, and also in the *Ornithorrynchus*, which has a Horny Papilla near the Pylorus.

In many of the *Glires*, the Stomach is uniform externally, but divided into pouches internally. In the *Rat* tribe, the greater number have two pouches, some three, some only one. In the *Hare* and *Rabbit*, it is also single, but has two apartments internally, formed by its inner Coats. The left portion is lined with a Cuticle, the right is Villous, and the food is observed to be more digested in the latter. In the *Opossum*, the Stomach is peculiar in having its two openings close together, resembling those of Birds. The *Beaver* has a Glandular Body at the Cardia, resembling the second Stomach of Birds. In the *Porcupine* there are three Stomachs of unequal size.

Of the *Feræ*, the *Kangaroo Rat* has the Stomach divided into two large Guts; and in the *Kangaroo Giant*, it forms only one, which is so large as almost to fill the Abdomen, and is formed into Cells by longitudinal Muscular Bands. There are two remarkable Appendices at the Cardia.

In *Carnivora*, the Stomach is larger in proportion than in Man, and is placed more in a longitudinal direction. It is also thicker and stronger, in consequence of which

which hard substances are more readily digested. In the *Dog*, the Rugæ go length-ways between the Cardia and the Pylorus; the Esophagus opens so freely into the Stomach, as to enable the Animal to vomit readily.

In the *Bear*, *Lion*, &c. the Stomach is divided by a slight contraction at its middle, into two portions. In the former, the Esophagus enters directly at the end of the Stomach. The *Cat* has a single Pyramidal Stomach. Among Amphibious Animals, as the *Seal*, some have a single Stomach, with the Esophagus entering directly at its extremity. In others again, as the *Trichecus*, or *Sea-cow*, it is complicated, and is remarkable, according to CUVIER, for having a Gland as large as a person's head, in which a fluid, like that of the Pancreas, flows into the Stomach by numerous pores.

Some Herbivorous animals, as the *Horse*, have the Stomach simple, and uniform in its appearance externally; but the inner surface has the left portion covered with Cuticle, as in the Esophagus, and the right Villous. The Muscular Coat has several Layers running in different directions.

In Herbivorous Animals in general, the Esophagus terminates in such a manner in the Stomach, as to prevent the ready return of the Food; and this is considered as one of the causes of these creatures not having the power of vomiting, like the *Carnivora*, excepting in extraordinary cases; in *Ruminants*, however, which do not vomit, the passage into the Stomach is free.

The inner part of the Stomach, in some other Animals, as the *Hare*, *Rabbit*, and several of the *Mouse* or *Rat* kind, has the left portion Cuticular,

while the right has the Villous appearance. In this, also, the Food is found to be more fully digested; from which circumstance this kind of Stomach forms a medium between that of *Ruminants*, and the Stomach of Animals that is entirely Villous on the inner side.

All *Pecora* have a plurality of Stomachs, some two, others three, and some four. In all of them, the Stomach is compound, and more complicated, both in structure and appearance, than in any other order of Mammalia. They are the only Quadrupeds which ruminate their Food. Taking the *Ox* for a general example of the structure of this Organ, the *first* Stomach is the *Ventriculus*, or *Paunch*, which occupies a great part of the Abdomen, especially in the left side. It is by much the largest of the four. It has two Sacs or Appendices externally, and is slightly divided into four apartments internally. The inner surface is covered with innumerable Papillæ, of different size in different parts.

The *second* Stomach is termed *Reticulum*, *Bonnet*, or *Honey-comb Bag*, and appears as a Globular appendage of the Paunch. It is placed at the right side of the Esophagus, and anterior part of the first, and has generally a thicker Muscular Coat than the former. Its inner surface is arranged into regular Pentagonal Cells, and covered with fine Papillæ.

The *third* is the smallest, and called *Omasum*, or *Many Plies*. It is situated on the right side of the Paunch, is of a Globular form, and has a thinner Muscular Coat than the two former. It consists of numerous broad Laminæ sent off from the Internal Coat, running in a longitudinal direction, alternately varying in

in breadth, and covered with small Granulous Papillæ.

The *fourth* Stomach, the *Obomasum*, *Ventriculus Intestinalis*, *Caille* or *Red*, has a Pyriform appearance, and is next in size to the Paunch. It has large longitudinal Rugæ, covered with Villi, in which circumstance it is somewhat like the Stomach of the *Dog*. The Muscular Coat is still thinner than that of the former. The fourth Stomach, in the Fœtus, with the Milk curdled in it, forms the *Runnet;* but it is observed, that in all Animals, there is only one digestive Stomach, and this has also the power of curdling Milk. The inner surface of the three first Stomachs is covered only with a fine Cuticle, while that of the fourth has the appearance of being a real Mucous or secreting Membrane.

Upon examining the openings of the Stomachs, the Esophagus is observed to open into the right of the Paunch, and at the same place by a Gutter, into the second and third Stomachs. The third leads in, by a narrow opening, to the fourth; and this terminates in the Duodenum, which has a Pylorus at its origin.

In the different individuals of this order, the Stomach varies in proportion as the Animal advances towards maturity. While it is young, and fed upon Milk, its fourth Stomach is the largest. The Milk passes at once into this Cavity, very little going into the other three. As soon as the Creature begins to eat Solid Food, it acquires the power of ruminating. It lays hold of the grass, &c. by pressing it with the Tongue against the roof of the Mouth, and, by the Gums

of

of the Upper and Teeth of the Under Jaw, assisted by a twist of the Head, tears it across. After a slight mastication, the Aliment passes into the Paunch, and from that, by small portions, into the second Stomach. When a considerable quantity has been swallowed, a morsel is thrown back with velocity from the Stomach into the Mouth, where it is accurately ruminated, and then carried directly to the third Stomach, the groove being contracted between this and the two first. This Process is continued till the whole of the Food has undergone the same operation. In the third and fourth Stomachs, a more complete digestion takes place.

The Stomachs of the other Horned *Ruminants* differ little in their nature from that of the *Ox*. In the *Deer*, the Paunch has three Pouches appearing externally, and the Papillæ are less conspicuous than in the *Ox*.

In the *Dromedary*, *Camel*, and *Lama*, there are four Stomachs, as in Horned *Ruminants*, but the structure is different. In the *Camel* and *Lama*, there are numerous Cells in the substance of the first and second Stomachs, formed by strong Muscular Bands crossing each other at right angles. By the action of these, it is supposed the Animals can open or contract at pleasure the mouths of the Cells, which serve as Reservoirs of the drink, so as to expel the contained fluids, or retain them even for several days. The water they take in is observed to be rendered turbid in the first Stomach, by the mixture with the Food, but becomes pure in the second. After rumination, the Animal can draw the third Stomach to the Esophagus, and receive the ruminated Food, without polluting the water in the Cells.

Of

Of the order *Bellucæ*, the *Pig* possesses a globular Stomach. The great Cul-de-Sac has an Appendix anteriorly, which makes this Organ appear double. The Pylorus has a large Tubercle, forming a kind of Valve, which can retard the passage of the Food.

The Stomach of the *Elephant* is about four times as long as it is wide. It has thick Rugæ, and five large Plicæ running transversely.

The Stomach of the *Rhinoceros*, with the whole Alimentary Canal, as examined by Mr THOMAS of London, was found, in external appearance, very similar to that of the *Horse*.

In the order *Cetacea*, the Stomach is complicated, as in *Ruminants*, consisting of three, four, or five divisions In the *Dolphin* and *Porpoise*, it is quadruple; but the Stomachs follow each other in succession.

OF

OF THE INTESTINES.

OF the Intestines in general.—The Intestines are in general longer in Mammalia than in the other classes of Animals. In *Birds*, *Reptiles*, and *Fishes*, they gradually become shorter, till at last they scarcely equal the length of the Body. The proportional length varies exceedingly in different Quadrupeds. In some, as the *Ram*, it is very great; in others, on the contrary, as in certain Species of *Bats*, the Intestines are only twice as long as the Body.

The length of the Canal corresponds with the Food upon which the Animal is accustomed to live. It is generally shorter in Carnivorous than in Herbivorous Animals; but to this rule there are exceptions. The *Seal*, which is a Carnivorous Animal, has a very long Intestinal Canal; the *Sloth*, on the contrary, has a very short one, though it feeds upon vegetables.

In Omnivorous Animals, as the *Rat* and *Pig*, the length of the Canal forms a medium between those which feed upon Flesh, and others living upon vegetable substances.

A difference of length has also been observed between the Intestines of wild and tame Animals, some of the former

former having the Canal shorter, and others longer, in proportion. In the *Wild Boar* and *Cat*, the length of the Canal, compared with that of the Body, has been found much less than in the tame Animals of the same Species. In the *Wild Rabbit*, on the contrary, it is considerably greater than in the tame one.

Mammalia, as well as most other Vertebral Animals, have a distinction into Small and Great Intestines. The Small are commonly the longest, and are Villous within. The Large are thicker in their Muscular and Internal Coats, and are seldom furnished with Villi internally; which last circumstance forms a distinction between the two parts of the Canal, when other marks are deficient.

In Carnivorous Animals, the Canal is generally more nearly equal in size than in the Herbivorous. The Muscular Coat is proportionally stronger, and there are no distinct Valvulæ Conniventes. From these circumstances, and also from the nature of the Aliment, the process of digestion is in them more quickly performed.

The *Horse* and *Elephant* are remarkable for the dimensions of their Colon, which, in the former, is several yards in length, while in a middle-sized *Dog*, it is only found to be about eight or ten inches long.

Many Quadrupeds, as the *Badger*, *Rell Mouse*, &c. have no distinction into small and great Intestines; but in such Animals, an Appendix or Cæcum forms the boundary between the parts corresponding with these. Where there is no Appendix or Cæcum, a Valve, corresponding to the Valvula Coli, points out the difference;

ence; and where even this is wanting, as in the *Sloth*, *Armadillo*, and *Hedge-hog*, the large Intestines are distinguished by the want of Villi, by the thickness of their Coats, and particularly by the strength of their longitudinal Muscular Fibres.

Carnivorous Quadrupeds, for the most part, have no proper Colon. Instead of it, many have a widened Intestine, but not tacked up by Ligaments into Cells.

On the contrary, Animals that feed on vegetables have a true Colon or Cæcum, or both; and the Colon is in general remarkably large in proportion, and divided into Cells by Tendinous Cords running lengthways, to retard the motion of the Food; but to the above rules there are many exceptions.

Among the *Carnivora*, some of the *Bat* tribe have a Cellular Colon. The *Opossum*, a real Carnivorous Animal, has a long Cæcum.

The Intestinum Cæcum is found in such Animals as have the Intestines distinguished into small and great. It appears merely as a prolongation of the great Intestine at the termination of the small; but it varies much in size, form, and structure, in different Animals, and not only in the same order, but in different Species of the same Genus. In many, particularly of the *Carnivora*, it is wanting.

In Carnivorous Animals, the Cæcum is small and uniform on its external surface, but is destitute of Cells. Exceptions occur to this rule, as some of the *Bats* and the *Opossum*, &c. which have the Cæcum of great size.

Herbivorous Animals in general have a large Cæcum, and this, like the Colon, is formed into Cells; but

Ruminants

Ruminants are excepted, their Cæcum being uniform, and of moderate size.

Omnivorous Animals, also, as the *Monkey*, *Rat*, and *Hog*, have generally a large Cæcum tacked up into Cells

Man, the *Ourang-outang*, and the *Phascolome*, (a New Holland Rat), are the only Animals yet found with a Cæcum and Appendix Vermiformis distinct. In most others, there is a Cæcum without an Appendix. in some *Ant-eaters*, two small Cæca: in other Animals, only an Appendix; and many have neither the one nor the other.

In Animals without a Cæcum, the Intestines are every where nearly equal in diameter, contracting only in a small degree towards the extremity of the Rectum.

The number of the Coats in the Intestines, in Mammalia, are the same as in the Stomach, varying in thickness and strength according to the size of the Canal, and the manner of living of the Animal. The Muscular Coat is generally stronger.

The Valvulæ Conniventes of the small Intestines are much less distinct in most of the Animals of this class, particularly the *Carnivora*, than in Man and the *Monkey* tribe. In some, however, even of the Herbivorous kind, they are entirely wanting.

The Villi are always present, and generally more evident than in Man. The Papillæ are very distinct upon the inner side of the Intestines in many Mammalia. In the *Seal*, they are remarkably conspicuous, and are found

found through the whole length of the posterior extremity of the small Intestine.

Of the Intestines in particular.—In the *Ape* kind, the Intestinal Canal bears a strong resemblance to that of Man; but the whole of them, except the *Ourangs*, want the Appendix Vermiformis.

The *Bradypóda* have the Canal of a moderate length, most of the Animals of this class being of the Carnivorous kind. The *Sloth*, on the contrary, living on vegetables, is remarkable for the shortness of the Intestines.

In the *Ornithorrynchus*, the structure of the Intestines differs from that in other Mammalia. There are many transverse Plicæ resembling those in Fishes; the Cæcum is in form of an Appendix Vermiformis; the Colon enlarges towards its outer extremity, forming a Cloaca, as in Birds. It has many Sinuosities in the right Hypochondrium; and upon the inner Membrane, Plicæ run in a longitudinal direction.

The *Bat* tribe, though Carnivorous, has a Cellular Colon and a large Cæcum. They have the Intestinal Canal the shortest of any of the Quadrupeds, being only once and a half, or twice the length of the Body. In the *Vespertilio Vampyrus*, on the contrary, or *Rousette*, which lives on vegetables, it is proportionally longer than in the Human Body.

Among the *Glires* or *Rodentia*, which feed upon vegetables, the Intestines are from six to sixteen times the length of the Body; but their diameter is not very considerable, though there is generally a very large Cæcum.

In

In the *Rat*, *Hare*, *Castor*, and *Porcupine*, the Cæcum is so large as to fill a great part of the Abdomen.

In the *Rat* tribe, which are Omnivorous, the Canal is shorter than in the other *Glires;* but the Cæcum surpasses the size of the Stomach, though it varies much in the different kinds. The Appendix Vermiformis, as already noticed, is found only in the *Phascolome.*

In the *Hare* and *Rabbit*, the Cæcum is longer than the whole Animal, and is furnished internally with a peculiar Spiral Valve. The Colon is also dilated.

In the *Beaver*, the Rectum and Urethra have a common termination.

Of the *Feræ*, the *Hedge-Hog* has neither a proper Colon nor a Cæcum. The *Badger*, which is not strictly a Carnivorous Animal, and the *Glis Esculentus*, or *Rell-mouse*, have no distinction between small and great Intestines. The *Hedge-Hog*, *Bear*, and some other Animals of this kind, that walk upon the soles of their feet, and are Omnivorous, have a long but narrow Canal, and no Cæcum, nor distinction of large Intestines.

In the *Opossum*, there is a long Colon, and a large Cæcum. The *Kangaroos* have no Cells in the Canal, but have a large Cæcum.

In the *Dog*, the Duodenum is fixed at the Pylorus to the Liver, but afterwards a large portion hangs loose in the Abdomen. The inner side of the Intestine has Valvulæ Conniventes, but placed in a longitudinal direction. The Cæcum makes turns upon the Ilium.

The Colon, furnished with a circular Valve, is small and short, as in other *Carnivora*, and, without making any circuitous turn, goes directly across the Abdomen to form the Rectum.

The *Cat* has the great Intestines considerably dilated, but the Cæcum is remarkably short.

Of the Amphibious Mammalia, the *Seal* has the Colon about double the size of the small Intestines, and the Cæcum is short and rounded. In the *Manatus*, or *Sea Cow*, the Intestines are scarcely six times the length of the Body, though the Animal is of the Herbivorous kind.

Solipeds have a much shorter Canal than the other *Herbivora*, but the great Intestines are enormously dilated. The Colon begins by a Cul-de-Sac, and its Cavity is divided into Cells by three strong Muscular Bands. The Cæcum is of a conical form, and so large as to equal the size of the Stomach.

Pecora, of all other Quadrupeds, have in general the Canal of greatest length, and the *Ram* has the longest of any. A great part of the Intestines, in this order, form concentric turns, and there is little difference with respect to their size. The Duodenum is large, and forms a kind of Pouch; but the Colon and Cæcum are of moderate bulk. They are uniform on their surface, and have no Ligaments tacking them up into Cells.

Of the order *Bellua*.—In the *Hog*, the small Intestines are united, and have conspicuous Papillæ. The Cæcum and Colon are of considerable size. In the *Elephant*, the Canal is short, but very large. The small

small Intestines have many large Valvulæ Conniventes. The Colon forms two transverse convolutions, like Pouches, which cover most of the Intestines. It is tacked up externally by longitudinal Muscular Bands, and has large Cells also internally. The Valvula Coli is of a circular form. The Cæcum is proportionally short, but very large, and, like the Colon, is formed into Cells. The inner side of the Canal has no Villi, but numerous short Papillæ.

In the *Rhinoceros*, the small Intestines are remarkably short, but the surface internally is increased in its extent by numerous Processes of an oblong form, covered with conspicuous Villi, and appearing to supply the place of Valvulæ Conniventes in Man. The Cæcum of this Animal is still larger than that of the *Horse*, and adds much to the bulk of the Abdomen.

The Intestines, in the *Hippopotamus*, have nearly same width for about two-thirds of their length, but afterwards become almost double the diameter throughout.

In the *Cetacea*, the *Whales* are observed to have their Intestines proportionally longer than the other *Carnivora*. There is no great difference in their size; they diminish gradually from the Pylorus to the Anus. They have no Cæcum nor Cells, but are furnished with longitudinal Plicæ of a zig-zag appearance, and are covered with Villi. In the *Porpoise*, the Guts are long, and, as in the other *Cetacea*, are all nearly of the same size, diminishing a little from the Pylorus to the Anus. There is no Cæcum, nor Valvulæ Conniventes, in any part of the Canal.

The Peritoneum and Mesentery exist in all Vertebral Animals, of course in the different Animals of this class, and are nearly of the same nature as in the Human Body, the Mesentery being longer or shorter, and running in a straight, or an oblique, or in a circular direction, according to the length and course of the Intestines. In many Quadrupeds, it is longer than in Man, partly owing to the depth and length of the Abdomen.

Of the Anus and its Muscles.—In Mammalia and Birds, the Anus is placed at the posterior extremity of the Trunk of the Body, directly under the origin of the Tail, and generally in a direction opposite to the Mouth. In almost all Mammalia, it is a simple orifice, which only gives passage to the Fæces. In the *Sloth* and *Beaver*, the Rectum and Urethra have a common termination. In the *Ornithorrynchus*, the end of the Rectum is remarkable, for dilating into a Bag, which receives the Fæces, Urine, and the Sexual evacuations.

The following numbers represent nearly the proportional length of the Intestinal Canal to that of the Body, in a few of the Mammiferous Animals mentioned in this work, the measurement being in a straight line from the Nose to the Anus. Taking the length of the Body as 1, that of the Intestines is as follows:—In the *Ape* tribe, varying from 6 to 8; in the *Sloth*, 3 to 1; *Ant-eater*, 3; *Armadillo*, 3; *Ornithorrynchus*, 5; *Bat*, 3; *Squirrel*, 12; *Rat*, 8; *Guinea Pig*, 16; *Wild Rabbit*, 11; *Tame Rabbit*, 9; *Beaver*, 9; *Hedge-hog*, 6; *Mole*,

Mole, 8; *Brown Bear*, 8; *White Bear*, 10; *Opossums*, from 2 to 3; *Kangaroo Rat*, 5; *Kangaroo Giant*, 10; *Dog*, 5; *Wild Cat*, 3; *Tame Cat*, 5; *Lion*, 3; *Otter*, 5; *Seal*, 28; *Horse*, 10; *Ass*, 9; *Camel*, 12; *Dromedary*, 15; *Ram*, 28; *Sheep*, 23; *Ox*, 22; *Deer*, 12; *Pig*, 16; *Asiatic Elephant*, 10; *African Elephant*, 7; *Walrus*, 6; *Porpoise*, 11.

OF THE LIVER, PANCREAS, AND SPLEEN.

Liver.

The Liver is found to exist, not only in the different individuals of this class, but in every class and order which have a Heart and Blood-Vessels. The Liver, in Mammiferous Animals, has nearly the same proportional size, and is almost of the same colour and structure, as in Man; but there are commonly a greater number of Lobes, and these more deeply divided than in the Human Body; the Porta, however, and its eminences, are wanting. The middle Lobe, when there are more than three, is generally divided by two Fissures, of which the right receives the Gall-bladder, the left the Suspensory Ligament.

In the *Ourang-outang*, the Liver is very similar to that in Man; but in the rest of the *Ape* tribe, the Lobes are deeply divided.

In some Animals of the orders *Bradypoda*, *Cheiroptera*, *Glires*, and *Feræ*, the Lobes are fewer; but in most of them, they are in greater number, and much more

more distinctly separated from each other, than in Man. In the *Feræ*, in particular, as the *Dog*, *Cat*, *Lion*, &c. the Fissures are very deep, and run through the whole mass. The Lobes divided in this manner, have been considered by some Authors, as allowing the parts to slide on each other, in Animals with very flexible Spines; while others are of a different opinion.

In the orders *Solipeda*, *Pecora*, *Belluæ*, and *Cetacea*, the Lobes are less numerous than in Man.

The *Hog* has four, but the *Horse*, *Ruminants*, *Elephant*, and *Cetacea*, have only two, and these not more separated than in the Human Subject. In the *Horse*, *Ox*, &c. with rigid Spines, the Liver is in one piece, and has no Ligamentum Latum, being sufficiently supported by the Muscles of the Abdomen.

Gall-Bladder.—The Gall-bladder exists in all the *Ape* tribe; in the *Bradypoda*, excepting the *Sloths*; in most of the *Feræ*, as the *Weasels*, the *Dog* and *Cat* kind; and in most *Ruminants*; but it is wanting in many of the *Glires*, particularly in several of the *Rat* tribe; in *Solipeds*; in the *Camel*, *Goat*, and *Deer*, among the *Ruminants*; in the *Elephant* and *Rhinoceros* among the *Belluæ*; and in the *Trichecus*, *Porpoise*, and *Dolphin*, among the *Cetacea*.

All the Mammalia that want a Gall-bladder are vegetable eaters, excepting the *Porpoise* and *Dolphin*.

Its situation is constantly under the right Lobe of the Liver, when there are two, and under the middle Lobe, when there are more than two. It has commonly a Pyriform appearance, as in the Human Body; but in many it is round or cylindrical.

The Biliary Ducts, in the *Ape* kind, are furnished with Cells in the Cystic Duct, the same as in Man. In other Mammalia, they have a smooth appearance; the *Kangaroo Giant*, however, has numerous Glands and Cells in the Hepatic Duct.

They vary much, in Mammalia, in their number, manner of uniting, and in their termination. When a Gall-bladder is present, the Hepatic Ducts commonly unite into one Trunk, which communicates with the Cystic; in other cases, they join it in succession. The Ducts terminate in the Duodenum, after piercing the Gut obliquely, much after the same manner as in the Human Body. The distance of the termination varies in different Animals. In the *Glires*, it is found to be the least; and in the *Kangaroo Giant*, among the *Feræ*, it is the greatest, though some Authors have supposed, that the Biliary Ducts terminated nearest the Pylorus in voracious Animals.

In the *Ornithorrynchus*, two Branches of the Hepatic Duct unite with the Cystic near the Neck of the Gall-bladder. In some of the *Bat* kind, in *Rats*, and in the *Porcupine* and *Hedge-hog*, many Hepatic Ducts join the Cystic near each other, or in succession. The *Mole* has two Hepatic Ducts, one of which receives the Cystic, then unites with the other to form the common Duct. In the *Seal*, one Branch of the Hepatic Duct joins the Cystic near the Neck of the Gall-bladder; the second unites with the Cystic near the insertion in the Intestine, and the Cystic Duct appears to form the common one.

The *Martin* kind have the common Duct dilated into

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a second reservoir. In some Animals, as the *Horse*, which are destitute of a Gall-bladder, the dilatation of the Hepatic Duct, at its origin, is so large as to form a sort of reservoir for the Bile. In the *Equus Quagga*, however, an Animal lately introduced into this country from the Cape, though the Gall-bladder is wanting, there is no dilatation in the Hepatic Duct. The Ductus Communis, in the *Cat* tribe, after perforating the Muscular Coat of the Intestine, forms an Ampulla with two apartments, previous to its termination. In the *Pig*, the Ductus Communis is of great size, and terminates very near the Pylorus. In the *Elephant*, nine or ten Biliary Ducts unite into a Trunk, which forms an oval Sac in the substance of the Duodenum. This divides into Cells, one of which terminates in the Intestine by a small orifice. In the *Dolphin* and *Porpoise*, the Hepatic Duct terminates in the last of the Stomachs.

Besides the Biliary Canals mentioned above, there are in some Animals, as the *Hare*, *Dog*, *Ox*, and *Sheep*, others, termed *Hepato-cystic*, which terminate in the Body or Neck of the Gall-bladder, and thus convey the Bile directly into it from the Liver.

PANCREAS.

The form, proportional size, and colour of the Pancreas, vary a little in different Quadrupeds; but the structure of this Conglomerate Gland is the same as in Man. In most Mammalia, it is separated into Branches, which extend in different directions, its principal part being always placed transversely behind the Stomach, and between the Spleen and Duodenum.

In

In the *Ourang-outang*, it is of the same figure as in Man. In the other Quadrupeds, it is less or more divided. There is commonly but one Pancreatic Duct; it seldom happens that any Branch goes off from it to terminate separately in the Duodenum.

For the most part, the Pancreatic and Biliary Ducts have a common opening. Of the *Apes*, some have the Ducts united; in others, and also in the *Hare*, *Porcupine*, and *Hog*, they terminate at a distance. In the *Dog*, one Pancreatic Duct goes into the Ductus Communis, and another into the Intestine. In the *Cat*, it terminates in one of the Cells of the Ampulla in the Ductus Communis. In most of the other *Carnivora*, the Pancreatic and Biliary Ducts are generally united. In the *Horse*, they terminate separately, though near each other. In *Ruminants*, they commonly unite at their termination. In the *Pig*, the Pancreatic Duct ends at a great distance from the Ductus Communis. In the *Elephant*, as in the *Cat*, it opens into one of the Cells of the Ampulla in the Ductus Communis.

Spleen.

The Spleen is found not only in all Mammalia, but in most Vertebral Animals, and is observed to diminish in the proportional size from Quadrupeds down to Fishes.

There is only one Spleen in Quadrupeds, but in the *Dolphin* and *Porpoise*, there are several of unequal magnitude, but so small, that if taken collectively, they would

would not equal the size of the Spleen in Quadrupeds.

The colour is commonly of a deeper red than in Man, but varies a little among the different individuals. The form also varies considerably. In many of the *Ape* tribe, it is triangular; in the *Ornithorrynchus*, quadrangular, and larger than the Stomach; among the *Glires*, triangular, as in the *Water Rat* and *Indian Hog*, or long and narrow, as in the *Rabbit;* in the *Carnivora*, generally long, prismatical, and flat; in the *Horse*, flat and triangular; in *Ruminants*, generally large and long, in some of these, in form of a crescent; in others, as the *Deer*, flat and roundish; in the *Hog* and *Elephant*, it is very long. The attachments of the Spleen are as in the Human Body, but it is often placed across the Abdomen. In *Ruminants*, it is fixed to the left side of the Paunch. The structure in the greater part of the Animals of this class, is somewhat similar to that in Man; but in the *Ox* and *Sheep*, it is peculiar for the appearance of its Cells.

OMENTUM.

THE Omentum exists in all the Mammalia, and is peculiar to this class, though something similar to it is observed in several other Animals. It varies less in its extent and general appearance in the same Species, than in Man. It commonly goes as far in one direction as the Kidneys, and in another, extends to the Pubes.

In the *Ourang-outang*, the Omentum is as in Man; but

but in the rest of the *Ape* tribe, it is similar to what is found in other Brutes. In *Carnivora* and *Ruminants*, its extent is very great. In a few Animals, on the contrary, as the *Brown Bear*, it does not reach the middle of the Abdomen.

The Omentum, in this class of Animals, frequently contains much Fat, and the spaces between the different Striæ of Fat are composed of the same kind of fine Membrane as in the Human Body; but the quantity of Fat depends greatly on age and manner of living. In Herbivorous Animals, it is generally furnished with more than in the Carnivorous; but in both, the quantity depends much upon rest. It is also affected by the season, moderate heat increasing the quantity; though, on the contrary, in Animals that remain benumbed in winter, the Omentum is charged with this substance.

Many of these, as the *Dormouse*, the *Marmot* of the Alps, &c. have, in addition to the Omentum, two fatty Appendices, which cover the Intestines in the lateral parts of the Abdomen; they have likewise a large quantity of Subcutaneous Fat, which may also serve as a reservoir of nourishment; but the fatty appendages are absent in some of the *Dormice*, the *Bear*, &c. though these Animals are of the same nature with those that have them.

KIDNEYS.

The structure of the Kidneys, in Quadrupeds, is analogous to that in Man; but they vary, in different Animals, in situation, form, relative thickness of their

two

two substances, and in the number and absence of Papillæ and Infundibula.

The situation differs from that in the Human Body, in the right being commonly higher, or, strictly speaking, farther forward than the left. The form is most frequently like that in Man, but sometimes Globular, as in the *Dog;* triangular, as in the *Horse;* and long, as in the *Hog;* but the greatest difference is in their division into Lobes. In many of the *Glires*, and in the different *Feræ*, they are simple, each having a Cortical and a Medullary part, with only one Papilla. In many individuals of the class, they form what are termed *Conglomerated Kidneys*, being divided, not only in the Fœtus, as in the Human Subject, but during life, into a collection of smaller Kidneys. In the *Ox* and *Elephant*, the Kidneys are separated into Lobes, of which there are in the former between twenty and thirty, and in the latter four; but they are deeply divided in the *Bear*, *Otter*, and other *Amphibia*, and in the *Cetacea*, so much so, as to appear like a bunch of grapes, and are connected only by their Sanguiferous and Urinary Vessels. These Lobes are for the most part numerous, being in the *Bear* fifty or sixty, and in some of the *Cetacea*, the number is still greater; but the cause of this division is not ascertained. It has been supposed that they are peculiar to Animals which live in Water, or frequent that fluid; but the *Brown* or *Land Bear* has the Lobular Kidney, as well as the *Polar* one, which inhabits the coasts and water.

The limits of the two substances are commonly distinct,

tinct, but they have not always the same proportional thickness; in some, the Cortical being three or four times thicker than the Medullary part. The Medullary Substance does not constantly terminate in Papillæ.

In the *Dog*, *Cat*, some of the *Opossums*, &c. the part which transmits the Urine forms a Cavity, the surface of which, however, is pale, like that of the Papillæ.

In many Animals, as the *Squirrel*, *Hare*, &c. there is but one Papilla; in some of the *Rat* kind, two; in the deeply-divided Kidneys, commonly but one in the Lobe; but in the *Bear*, each Lobe is found to have two Papillæ.

The number of Infundibula corresponds with that of the Papillæ; when these are absent, the Pelvis is joined to the edges of the surface which sends out the Urine, and then, as happens in the *Cat*, it does not appear beyond the Kidney.

In the *Bear*, and other Animals with Conglomerated Kidneys, the Infundibula unite in succession, and go to the Ureter without forming a Pelvis.

The Ureters agree, in Mammalia in general, in their course, size, proportional length, structure, and termination.

In the Lobulated Kidneys, the Arteries do not all go into the Sinus of the Kidney, many of them taking a more direct course towards the Lobes to which they are destined.

Renal Glands.

The Renal Gland is generally situated at the inner part

part of the Kidney, and varies in proportional size almost in every Species; but it appears to change with age much less than in Man. Its use here, as in the Human Body, has not been discovered, though it is considered as subservient to the Kidney.

Among the *Glires*, it is proportionally large, being from a 12th to a 4th part of the bulk of the Kidney; while, in the *Feræ*, it is in general not more than a 20th or a 50th part.

The form, also, of this substance is very various. In *Solipeds* and *Ruminants*, it is often round, or cylindrical, or conical. In many Animals, its external appearance is very similar to that of the Kidney. In the *Cetacea*, it is divided into numerous Lobules, which have generally two distinct substances, the outer yellowish, the inner deep brown, and softer than the outer. The external is often more than half the thickness of the Gland; but the colour and distinction of substance vary much in different Animals. In some, as the *Elephant*, this is scarcely observed; in others, as in some of the *Glires*, three or more substances of different colours have been found.

BLADDER.

ALL Mammalia have a Bladder of Urine, but it is more loose than in Man, and is completely covered by the Peritoneum. The shape is also different; the bottom, or Fundus, on account of the horizontal situation of the Animal, being most dependent, becomes the widest part. In Herbivorous Animals, particularly in

in the *Pecora*, the Bladder is much larger, and more dilatable, but less thick and strong, than in the *Carnivora*; hence the latter are observed to evacuate the Urine more frequently.

The structure of the Bladder varies in these two kinds of Animals. In *Carnivora*, it is commonly composed of strong Fasciculi of transverse and longitudinal Muscular Fibres. Some Herbivorous Animals, as the *Horse*, have also a thick Muscular Bladder; while other *Herbivora*, and some Omnivorous Animals, as the *Ape* tribe and *Hog*, have the Bladder proportionally not thicker than in Man.

OF

OF THE MALE ORGANS OF GENERATION.

Testes.—The Testes are found in all Male Animals, except in those of the very lowest orders. In the different Mammalia, as in Man, they are two in number; but there is considerable variety in their situation and structure.

In the *Ape* tribe, in most of the *Carnivora*, in *Solipeds*, and in most *Ruminants*, they are placed in a Scrotum, with a Cellular Partition between them. They are pendulous in such Animals as have Vesiculæ Seminales, in which the Semen is readily conducted to the Penis. In the *Kangaroo* and *Opossum*, they are placed at the fore part of the Pelvis, in a Scrotum without any partition. In the *Belluæ* and *Civet*, they are situated under the Skin of the Perineum. In the *Otter* and *Camel*, they lie under the Integuments of the Groin.

In the *Bat*, *Squirrel*, *Rat*, *Guinea Pig*, *Beaver*, *Porcupine*, *Hedge-hog*, *Shrew*, *Mole*, &c. they pass from the Abdomen into the Scrotum, upon certain occasions, particularly at their seasons of sexual intercourse.

In the *Ornithorrynchus*, *Elephant*, *Amphibious Mammalia*, and *Cetacea*, they remain constantly in the Abdomen,

domen, in the vicinity of the Kidneys; and here, as in other cases where they are situated within that Cavity, they are covered by the Peritoneum, but want the Cremaster Muscle, which exists wherever the Testicle passes out of the Abdomen.

Besides the Scrotum, the Testicle, as in Man, has its Tunica Vaginalis, and unless in Man and the *Ourang-outang*, there is constantly a small passage leading between this Coat and the Abdomen, in such Animals as have the Testes always in the Scrotum, but a large communication in those in which these Glands pass from, and to the Abdominal Cavity. In neither of these cases is the Animal in danger of Hernia, this being the highest part of the Belly, or at least, the Viscera press less upon the Abdominal Rings. The Testes are covered also in Mammalia by the Tunica Albuginea, which differs only in thickness. The form of the Testes is generally oval, sometimes round, as in the *Rat*, or very long, as in Amphibious Mammalia and *Cetacea*. The size, in many, increases greatly at rutting-time.

The Seminal Tubes, in some Animals, are collected into Bundles, as in the *Baboons*, most of the large *Carnivora*, the *Boar*, &c.; but in most of the *Glires*, and especially the *Rats*, the Tubes are large and parallel, and so loosely connected as to be easily separated from each other.

In several Quadrupeds, as the *Dog*, *Horse*, *Ram*, &c. there is a Body termed *Corpus Highmorianum*, running longitudinally next the Epididymis, and composed of condensed Cellular Substance, which sends Septulæ between

tween the different Bundles of the Seminal Tubes of the Testicle, to protect and bind these together.

The form and relative size of the *Epididymis* varies much in different Animals. In most Mammalia, it is fixed to the Testicle, as in Man; but in many of the *Glires*, as the Rat, and in Animals with a Pouch, it is connected to the Testicle only by two thin Cords.

The *Vasa Deferentia*, as in Man, are thick and firm, but thinner when the Testes lie constantly in the Abdomen. As in the Human Species, also, the Vasa Deferentia, in many Animals, are enlarged, and are Cellular internally, for some space previous to their termination. The Cells, in the *Horse*, and also in the *Ram*, have small orifices internally, from which a thick white fluid can be pressed into them. In the *Elephant*, the dilatation is of a Globular form.

Most Mammalia possess *Vesiculæ Seminales*, which, in many, as in some *Apes*, but particularly in the *Hedge-hog*, are greatly enlarged, like the Testicle, when these Animals are in season. The Vesiculæ exist in *Apes*, in *Bats*, in the *Glires*, in the *Hedge-hog* and *Racoon*, in *Solipeds*, and in the *Belluæ*.

They are wanting in the *Ornithorrynchus*, in *Carnivora*, in *Ruminants*, unless two small Glandular Capsules, considered by some as Prostate Glands, be taken for such,—and in the *Cetacea*. There is no rule yet known with respect to the presence or the absence of these.

Their form and structure vary exceedingly in different Mammalia. They are commonly Membranous and Cellular, but in many cases they have a Glandular

appearance internally. When very large, as in the *Elephant*, they have a peculiar Muscle which covers them. In many Animals, each Vas Deferens unites with the Vesicula of its side; in others, the Vasa Deferentia and Ducts from the Vesiculæ terminate by a common opening in the Verumontanum.

In the *Ape* tribe, the appearance of the Vesiculæ Seminales is nearly the same as in the Human Body. In most of the *Glires* they are remarkable for their great size. The Vesiculæ of the *Squirrel* are particular, in being placed upon the inner side of the Vasa Deferentia. In the *Rat*, they are so large as to be partly without the Pelvis. The *Guinea Pig* has them of a long cylindrical form, and containing a cheesy-like substance. In the *Hare*, their place is supplied by a rectangular Sac, which has in one part a Glandular appearance, and opens into the Verumontanum along with the Vas Deferens. In the *Hedge-hog*, they exceed the size of the Testes, forming on each side four or five Fasciculi, each of which is composed of a Tube wonderfully convoluted. The different Tubes join into one Canal, that opens into the Verumontanum along with the Vas Deferens. In the *Horse*, *Boar*, *Elephant*, and *Rhinoceros*, the Vesiculæ are of great size, and form on each side a common Duct with the Vas Deferens.

Vesiculæ Accessoriæ.—These are Membranous Tubes, varying in number, and situated at the inner side of the Vesiculæ Seminales, or at the origin of the Urethra. They terminate by one or more Excretory Ducts, in common with the Vesiculæ Seminales and Vasa Deferentia.

ferentia, or separately. They are like the Vesiculæ Seminales in structure, and increase like them at rutting-time. They are observed also to be filled, apparently with the same kind of liquor.

They exist in most of the *Glires*, as the *Rat*, and in the *Hedge-hog* and *Mole* among the *Carnivora*, but appear to be wanting in the other Mammalia, the *Horse* excepted, in which there is a cylindrical Vesicle placed between the Vasa Deferentia, and terminating in the Urethra, before the openings of the Vesiculæ Seminales and Vasa Deferentia.

Prostate Gland.—The Prostate Gland, or something analogous to it, appears to exist in all the Mammalia, but varies exceedingly in its appearance in the different Species. In some, as the *Dog* and *Cat* tribe, it is single: in others, as *Ruminants*, it is double. In a small number, as the *Horse* and *Elephant*, it is quadruple; and in the *Bat*, it is lobulated.

In most of the Animals of the class, the structure is as in Man. In others, as the *Horse*, *Ruminants*, and the *Elephant*, it has Cavities within. In the *Cetacea*, it is Cellular, and of great proportional size. It generally surrounds the beginning of the Urethra, and terminates in that Canal, by one or more openings, at the side of the Verumontanum, though sometimes considerably farther forwards.

In the *Horse* and *Elephant*, the Prostates are covered by Muscular Fibres, which proceed from the sides of the Bladder.

In most of the *Glires*, and in the *Hedge-hog* and

Mole, the place of the Prostate is supplied by the Vesiculæ Accessoriæ.

Cowper's Glands.—They exist in most Mammalia, but are wanting in many, as the *Hedge-hog*, *Mole*, *Dog*, some of the *Bear* tribe, *Otter*, *Solipeds*, many *Ruminants* as the *Deer*, in the *Seal*, and in the *Cetacea*.

They are frequently found with the Prostate and Vesiculæ Seminales, or with the Vesiculæ Seminales and Vesiculæ Accessoriæ, or with the Prostate alone.

Their structure varies considerably among the different Animals; sometimes they have a dense texture, as in the *Ape* tribe, *Carnivora*, and *Ruminants*; at other times, they have a Vesicular appearance, as in the *Squirrel*, *Marmot*, &c.

They are constantly filled with a peculiar liquor, of a bluish-white colour, of the consistence of thick mucilage, which passes into the Urethra by a single Duct. In *Apes*, they are proportionally much larger than in Man. In the *Cat* kind, they are also remarkable for their size. In general, they have a Muscular Sheath which incloses them, and may enable them to expel the fluid which they contain.

The number of these Glands is remarkable in Marsupial Animals, four being found in some, and six in others.

PENIS.

The Penis, in Mammalia, is constantly single and pervious, and varies in size, form, and situation. In the *Ape* tribe and *Bats*, it is suspended from the Pubes,

as

as in the Human Body In the greater number of Quadrupeds, it passes towards the Umbilicus, where there is an orifice for its exit, and in its course is inclosed in a sheath of the Integuments, lined in some by a Cellular, and in others by a Ligamentous Substance. When relaxed in the sheath, it turns more or less in a waving direction, on account of its length. In most Animals, it is situated under the Abdomen, having on each side one Muscle, which arises from those at the middle of the Abdomen, and is fixed to the Prepuce, and another, arising from the Vertebræ of the Tail, or Muscles about the Anus, and inserted along the Penis, as in *Carnivora*, or in the sheath that covers it, as in *Ruminants*. The first is the Adductor, and the other the Retractor, of the Prepuce.

In some Animals, as the *Squirrel*, *Dormouse*, *Rat*, *Marmot*, *Guinea Pig*, *Hare*, *Opossum*, *Lion*, and *Camel*, the Penis goes to the anterior part of the Pubes; or in some, it passes directly out of the Pelvis, then proceeds to the side of the Anus. Animals of this last kind are termed *Retromingents*, the Urine being voided backwards in both sexes, and they are, contrary to an ancient opinion, found to copulate forwards, like other Quadrupeds.

In the *Cetacea*, the Penis is long, slender, in the form of an *f*, and is situated within the Abdomen. When they copulate, the Female turns upon her back, and the Male slides on.

The length of the Penis varies according to its situation. In the *Lion* and *Cat* kind, it is so short, that the Male uses his Teeth and Claws, to enable him to cling

better to the Female during copulation. The form is as variable as the length in this class. It is somewhat cylindrical in the *Ape* kind and *Glires*, slender in the *Boar* and *Ruminants*, cylindrical in the *Horse* and *Elephant*, large and conical in the *Porpoise*, and large, conical, and flat in the *Dolphin*.

The Crura Penis, in Mammalia, are proportionally short. They adhere to the Bones as intimately as in Man.

In the *Dog* and some *Apes*, there are two Corpora Cavernosa, with a Septum Penis; in others of this last tribe, the Septum is wanting or incomplete. It is absent in *Solipeds*, *Ruminants*, and *Cetacea*, and in most *Belluæ*; in which case, there is only a single Corpus Cavernosum. In the *Elephant*, there is a complete Septum.

The *Ornithorrynchus* and *Kangaroo* are remarkable for having four Crura Penis, and the Urethra in the axis of the Corpora Cavernosa, which form a cylindrical ring, with a Septum both above and below it.

In several Mammalia, there is a *Bone* in the Penis, for conducting it into the Vagina. This is found more frequently in such Animals as have no Vesiculæ Seminales; in these the copulation being tedious, they turn averse from each other during the emission of the Semen. But it is found also in some where these Bodies are present. It exists in most of the *Ape* tribe, though here it is small; in *Bats*, and in several *Rats*; in the *Badger*, *Bear*, *Weasel*, *Dog* and *Cat* kind; in the *Seal*, and in the *Balena* among the *Cetacea*. It is wanting in the *Opossum*, *Hyena*, *Solipeds*, *Ruminants*, and *Bellucæ*. When present, it makes part of the walls of the Penis,

Penis, the Corpora Cavernosa being then less extensive. It is commonly cylindrical, though sometimes furrowed, making part of the Urethra. In the *Bear*, *Dog*, &c. it forms a large part of the Penis. In most of the *Glires*, and in the *Cat*, it is proportionally small.

The Urethra, as in Man, is continued from the inner lining of the Bladder. In the *Horse*, it has been observed to have, externally, transverse Muscular Fibres from one extremity to the other. It is divided into a Posterior and an Anterior Portion; the former, at the sides of the Verumontanum, receives the Semen and liquor of the Prostate Gland.

The posterior portion of the Urethra varies in length in different Genera. In some *Apes*, it is short, as in Man. In some other Animals, as the *Civet Cat*, *Kangaroo Rat*, it is about half the length of the Canal.

This portion is termed by some *Muscular*, as being inclosed in a layer of Muscular Fibres, running more or less in a transverse direction; and in some, as *Solipeds* and *Ruminants*, it is of considerable thickness and strength, thereby assisting in the expulsion of the Semen.

The other portion of the Urethra begins by a Bulb, and is commonly placed under the Corpora Cavernosa, and inclosed by walls of the same nature with those of these Spongy Bodies. It begins behind by two Crura, each inclosed in a separate Muscle. The Bulb of the Urethra is thin in *Carnivora*, but of considerable strength in *Solipeds*, *Ruminants*, and *Belluæ*.

The *Glans Penis* varies, in form and structure, almost

in

in every Genus. In some, as the *Ape* tribe and *Horse*, it is dilated somewhat, as in the Human Species. In others, as the *Boar*, and many *Ruminants*, it is conical and pointed, and in some turned to one side. Many others, as the *Carnivora*, have it also conical, but with the addition of the *Os Penis*, which commonly projects to the extremity of the Glans. In the *Elephant*, it is cylindrical like the Penis, and then contracts at the extremity.

In many, the Glans has a Tendinous appearance. In some, it is covered with hairs; in others, with scales; and some of the *Cat* tribe have retroverted Spinous Processes, which may assist in enabling the Male to cling to the Female till the Semen is evacuated.

In the *Badger*, *Dog*, &c. or such as have the copulation tedious, there is a double Glans, or two Cavernous Prominences, one in the Body of the Penis, the other near its extremity. Behind the Prominences are two Veins, which are compressed by Muscles in the time of coition; in consequence of which, the return of the Blood is prevented, and the double Glans kept in a state of distension. Something of a similar nature is produced at this time in the Female; the Vagina and its Corpus Cavernosum are contracted, by which the Animals are held together, and often, contrary to their inclination, till the Semen is evacuated, and the parts relaxed.

In the *Opossums*, the Glans is divided into two parts, each of which is perforated for the transmission of the Semen. At the division of the Glans, is the passage for the Urine.

In the *Echidna* and the *Ornithorrynchus Paradoxus*, the

the Urethra, destitute of Cavernous Substance, is inclosed along with the Rectum, by a Constrictor Muscle, which terminates in the Cloaca, that receives the Semen and Urine. The Penis is of considerable size, and, in the relaxed state, is situated in a Pouch. It terminates by two pervious Papillæ, which conduct the Semen. The *Ornithorrynchus Hystrix* has a similar structure, but has a quadrangular Glans.

Muscles, &c. of the Penis.—The Erector Penis, and Accelerator Urinæ, exist in all Mammalia, but vary according to circumstances. Besides these, certain Animals, as some of the *Apes*, the *Dog*, *Hare*, *Ruminants*, the *Elephant*, &c. have others, for supporting and giving proper direction to the Penis.

Of the Blood-vessels, the Arteries are nearly of the same nature as in Man. The Veins form an intricate Plexus on the Dorsum Penis, from which Branches go to those of the Groin. The Nerves are comparatively very large, and embrace the Veins as well as the Arteries.

OF

OF THE FEMALE ORGANS OF GENERATION.

THE Female Parts in Mammalia may, as in the Human Body, be divided into Internal and External, which vary much among the different individuals of the class.

The Uterus is situated horizontally like the Body. It advances in the Loins to the back part of the Kidneys; is thinner, looser, and more tender, than in the Human Species; and has, internally, a Glandular Membrane, but wants the transverse Rugæ, which are found in Women. In general, it resembles an Intestine, and has a real Muscular Coat.

Of the variations of the Uterus, there is,

1. A *Simple Uterus without Horns*, and this generally pyramidal or oval, as in the *Ape* tribe, among the *Quadrumana*, and in the *Toothless Animals* and *Sloth*, in the order *Bradypoda*.

2. A *Simple Uterus with Horns*, or *Uterus Bicornis*. This, in some, is straight, in others convoluted, as in the greater part of the *Glires* and *Carnivora*, *Solipeds*, *Ruminants*, *Belluæ*, and *Cetacea*.

3. A *Double Uterus*, or *Uterus Duplex*, having the appearance

appearance of two Horns, which open separately into the Vagina, as in the *Hare* and *Rabbit*.

4. A *Double Uterus* with extraordinary lateral convolutions, or *Uterus Anfractuosus*, as in the *Opossum* and *Kangaroo*. The Uterus of these Animals has several longitudinal folds, one of which runs through its whole length, and divides it into two equal parts. The Cornua Uteri, contracted at first, soon dilate into large Cavities, each of which sends out a narrow Fallopian Tube, which is fixed to the extremity of the Ovarium. From the corners of the Uterus, on each side, a Canal arises, which, after making a circuitous turn, approaches its fellow, and terminates in the Vagina, by a narrow orifice, at each side of the Meatus Urinarius.

The *Ovaria* are as constant in the Female, as the Testes are in the Male. They are frequently situated near the Kidneys, are of an oval form, and have the Ova buried in their substance.

In the *Pig*, they are tuberculated; in the *Hedge-hog*, they are in the form of a cluster of grapes. The number of the Ova corresponds with that of the young, which the Female is capable of producing during her life.

The structure of the *Uterine Tubes* is generally the same as in the Human Species. In Uteri with Cornua, they are fixed to the latter, and are convoluted; but their diameter is always smaller than that of the Cornua.

The *Vagina* is a continuation of the Uterus, and lies in the same axis with that Organ. It is in proportion to the size of the Penis in the Male, and to that of the Fœtus, which has to pass through it. It has generally Rugæ running longitudinally, to favour its dilatation.

In

In a few, as the *Hyena*, *Dolphin*, and *Porpoise*, the Rugæ run transversely, but exist only at the outer half of the Canal. In large Animals, the walls of the Vagina, according to CUVIER, possess Muscular Fibres, which run both in a longitudinal and in a transverse direction. In the *Ornithorrynchus*, there is no Vagina.

Vulva.—This, in some Animals, as the *Rat*, forms a longitudinal slit; in others, as the *Hyena*, it passes transversely. In some of the *Glires*, it is of a circular form, and sometimes, especially in Animals with a Pouch, it is inclosed with the Anus in a circle.

The existence of a *Hymen* in Quadrupeds, resembling in form and situation that of the Human Subject, is asserted by some late Authors of the first eminence, and denied by others of equal celebrity.

In the *Dog*, *Cat*, *Ruminants*, &c. the Vagina is separated from the Vulva, by a contracted circle, and in other Animals, by one or more Plicæ, which are found to be effaced by coition, or by one or more litters. In the *Bear*, *Hyena*, *Mare*, and *Ass*, never yet covered, a strong Semilunar Fold appears in the under part of the orifice of the Vagina, which has been considered by some as analogous to a Hymen, though this is no very strict resemblance to that in the Human Female.

At the under end of the Vulva, the *Urethra* is commonly situated, and appears at the outer orifice of the Vagina, though, in many Animals, the orifice of the Urethra is a considerable way in from the Vulva.

The *Nymphæ* are wanting in Mammalia; but the want of them is supplied, in coition, by the quantity of Blood which distends the Vessels at this time. In place of

of Labia Pudendi, there is generally a thin border of the Integuments.

A *Clitoris* is found in Quadrupeds in general, but placed in the lower part of the Vulva, corresponding with their horizontal situation. In the *Ape* tribe, it is larger than in Women, and is also of considerable size in most of the *Glires*, and in the *Carnivora*. The Prepuce covering it forms, in some, as the *Bear*, a Pouch; in others, as the *Bitch*, a Cul-de-Sac.

In Animals where the Male has an Os Penis, the Female has a small Bone in the Clitoris, as in the *Glires*, the *Bear*, *Cat*, *Lioness*, &c.; but it is not found in the *Dog* kind.

In the *Rat* tribe, the Clitoris and orifice of the Urethra are placed in front of the Vagina, appearing like the parts of a Hermaphrodite.

In the *Opossum*, the Clitoris has a Bifid Glans, corresponding with that in the Penis of the Male. In the *Lemur Tardigradus*, belonging to the order *Quadrumana*, the Urethra runs through the Clitoris, and terminates upon its extremity.

GRAVID UTERUS.

The changes which the Uterus undergoes by Impregnation, vary according to the nature of the Animal to which it belongs. The *Os Tincæ*, in all the different Mammalia, is closed soon after Impregnation, by a Glutinous Mucilaginous Matter, secreted by Glands or Follicles, which cuts off all communication between the internal

internal and external parts, and prevents the lips of the Womb from growing together.

The *Corpora Lutea* are found after impregnation, and, in the *Cow* in particular, are large and of a yellow colour; but in other Animals, the colour varies according to the kind.

The Muscular Fibres in the Gravid Uterus become less distinct than in the unimpregnated state. The changes of the simple Uterus without Horns, or that belonging to the *Ape* tribe, &c. considerably resemble those in Woman.

In the Uterus with Horns, the changes are according to the number of Fœtuses the Mother carries. In Uniparous Animals, as the *Mare*, the Fœtus is confined to the Uterus. In the *Cow*, it extends from the Uterus to one of the Cornua. In Multiparous Animals, one or more Fœtuses are contained in each Horn; in which last case, the Cornua, by their alternate contractions and dilatations, are formed into Cells.

The Uterus Anfractuosus has the thinnest Coats of any, and suffers the least change by Impregnation. In the *Kangaroo* after Impregnation, the communication between the Vagina and Lateral Canals is completely shut up by inspissated Mucus. A minute orifice is described as being now close to the Urethra, and communicating with the Uterus, though no opening is found here in the Virgin state. This, dilating at the time of parturition, is found to discharge the Fœtus into the Pouch or False Belly; the parts, after delivery, returning to their original state. In the *Opossum*, the changes by Impregnation are not yet ascertained.

The connection between the impregnated Uterus and surface

surface of the *Ovum* is effected, in Mammalia, in three different ways.

1. In some, as in the *Mare* and *Sow*, the whole external surface of the Ovum adheres to the Uterus firmly, or a bag-like Placenta is formed.

2. There is a simple *Placenta*, Orbicular in some, as in the *Ape* tribe and most of the digitated Mammalia, or forming a Zone or Belt, as in the *Dog* and *Cat* kind, &c. In several of the digitated Mammalia, the external surface of the Placenta has a white Glandular-like Body, or Corpus Glandulosum, inclosed in it, which admits of the easier separation of parts towards the latter period of Gestation.

3. A third kind of connection is found in *Ruminants*, where there are numerous *Placentulæ*, or *Cotyledons*, upon the surface of the Ovum. These adhere to Glands, produced from the inner side of the Uterus. The *Glandulæ Uterinæ* have many Papillæ and Caverns, corresponding to Caverns and Papillæ or Processes of the Placentulæ. They are very Vascular, and possess a milky-like Liquor, which can be readily squeezed out from them; but no injection can be made to pass from the Vessels of the Placentulæ to those of the Glandulæ.

The Cotyledons and Glandulæ adhere to each other, the former inclosing the latter, from which comes their name; but they can be readily separated from each other at the latter period of gestation.

The Cotyledons are discharged with the After-birth, the Glandulæ gradually diminishing in size after the contents of the Uterus have come away, but exist in the Uterus both in the gravid and unimpregnated state.

The number and form of these excrescences vary in different Animals. In the *Sheep* and *Cow*, they are from seventy to a hundred. In some Animals, they are concave externally; in others, convex.

The *Involucra* of the Fœtus consist of the outer Membrane, or *Chorion*, and the inner one, or *Amnios*, that secretes the liquor in which the Animal swims. The two Membranes, contrary to what happens in the Human Species, are covered with Blood-vessels derived from those of the Umbilical Cord.

Between the Chorion and Amnios, in most pregnant Mammalia, the *Cetacea* not excepted, there is an *Allantois*, or Bag, but destitute of Blood-vessels, which receives the Urine from the Bladder by a Canal termed *Urachus*.

In *Solipeds*, the Allantois is every where interposed between the other two Membranes. In the *Cow* and *Sheep*, it covers only part of the Amnios; and in the *Sow*, it covers only a small part of that Membrane.

In the *Mare* and *Sow*, there is a fleshy-like mass contained in the Allantois, which has been considered by some as the sediment of the Urine, and termed *Hippomanes*, or *Horse-venom*, the nature of which is imperfectly understood.

The Allantois is wanting in the *Ape* kind, and in the *Hedge-hog*, *Dog*, *Cat*, &c. in which is found a Membrane, termed *Tunica Erythroides*, which contains a watery fluid at the commencement of pregnancy, and is connected to the Mesenteric Vessels of the Fœtus, but has no Urachus. Like the Vesicula Umbilicalis in the Human Fœtus, this is more immediately connected with early pregnancy.

The

The *Umbilical Cord* is observed to be proportionally shorter in Quadrupeds than in the Human Species. In most of them, there are two Umbilical Veins, united into a Trunk near, or within the Body of the Fœtus. In the *Foal*, the Cord has only a single Vein.

OF THE FŒTUS, AND ORGANS WHICH NOURISH IT FOR SOME TIME AFTER DELIVERY.

The peculiarities of the Fœtal Quadruped, with respect to structure, are not much different from those in the Child at the end of pregnancy.

The number of young produced, at a time, varies according to the kind, and is observed to be greater in tame than in wild Animals, as in the *Sow* and *Cat*.

The *Whale* produces only a single Fœtus, and once in two years. In suckling, she turns almost on her back, on the rim of the water.

The nourishment of the Fœtus, in Mammalia, is derived from the Mother's Milk, which is secreted from the Mamma, and is peculiar to the Animals of this class.

The situation and structure of the Mamma vary according to the number of Fœtuses which the Animal produces at a time. In Uniparous Animals, they are generally situated between the Hind Legs. In the Multiparous, they extend, in some, along the Abdomen, and in others, also along the Thorax. The Mamma is surrounded with less Fat in proportion than in Women; hence not bulky, till distended with Milk.

The situation and number of the Teats projecting

from the Mamma vary much. In general, though with many exceptions, the number is about twice that of the Fœtuses which the Animal commonly produces at a Birth, to give, along with the extended Mamma, an opportunity for suckling all the young at the same time.

The Teat is commonly hollow within, the Cavity communicating with two reservoirs, in which the Lactiferous Tubes terminate. It has only one or two orifices externally.

Of the number of the Teats in Mammalia, there are generally,

Two Inguinal in the *Sheep*, *Goat*, *Mare*, and *Cetacea*.

Four Inguinal in the *Cow*, *Deer*, and *Camel*.

Four Abdominal in the *Lioness* and *Panther*.

Ten Abdominal in the *Sow*.

Six Abdominal, and Four Pectoral, in the *Bitch*, *Hare*, and *Rabbit*.

Four Abdominal, and Four Pectoral, in the *Cat*.

Eight Abdominal, and from Two to Four Pectoral, in the *Rat*.

Two Abdominal, and Four Pectoral, in the *Bear*.

Four Abdominal, and Six Pectoral, in the *Hedge-hog*.

Two Pectoral in the *Ape*, *Bat*, and *Elephant*.

The Nipples are sometimes found, but in smaller number, in the Male, as in the *Dog*; or in a different situation, as on the sheath of the Penis in the *Horse*; and there are numerous instances where Milk has been secreted in the Mammæ of Male Animals, as the *Dog*, *Cat*, &c.; and Milk, or a fluid similar to it, is commonly found in the Mammæ of newly-born Quadrupeds of both sexes, as well as in the Breasts of Children.

In

In the Marsupial Animals, as the *Kangaroo* and *Opossum*, there is a Bag or Pouch, formed by the Common Integuments, and lined thinly with Hair. It is connected with a pair of Bones arising from the Pubis, which have Muscles for raising them, and the Pouch along with them. It is closed by a Sphincter Muscle, and opened by its own relaxation, or by a Muscle which draws the Pouch towards the Vulva, to receive the young at the time of delivery.

Whether the Embryo ever possesses an Umbilical Cord, or a connection with the Uterus similar to that in other Quadrupeds, is not ascertained; nor is the exact time at which the Fœtus enters the Pouch been hitherto pointed out: but it is observed, that at an early period of pregnancy, the Fœtus, scarcely an inch in length, passes from the Uterus through the Vulva into the False Belly, where it adheres by its Mouth to one of the Nipples, placed there for its nourishment. When the Animal arrives at a certain degree of maturity, it goes out of the Pouch, and re-enters it at pleasure, till it has acquired strength enough to provide for itself. (*See* Mr Home's Paper on this subject in Phil. Trans. 1795.)

No False Belly is found in the Male of these Animals.

PART II.

OF BIRDS.

OF THE BONES.

THE *Skeleton* of Birds has a considerable uniformity in the whole class, and bears a strong analogy to that of the Mammalia; but the large Bones, in Birds of whatever shape, are destitute of Marrow in their internal Cavities, in place of which they contain air, and communicate with the Lungs by considerable apertures. Fœtal Birds, however, or such as have just quitted the Shell, have their Bones filled with Bloody Marrow, which, in general, is soon absorbed, and, in Aquatic Birds, the greater part disappears.

The *Scull*, in this class of Animals, has no Sutures, at least in the Adult state, but is in a manner consolidated into one piece. In young Birds, there is a kind of False Sutures, but these are soon obliterated. The Cranium is of a Cellular texture, and particularly so in some, as the *Eagle* and *Owl*, by which the strength and bulk of the part is increased, and the Body rendered specifically lighter. Some Birds are remarkable for a Crest or Horn, on the upper part of their Head. Eminences of this kind are united with the Frontal Bone, and

and may be considered as enlargements of the Orbitar Portions.

The Cavity of the Cranium is divided into two principal Fossæ, one for the Cerebrum, the other for the Thalami Optici, Cerebellum, and Medulla Oblongata.

The number of the Bones of the Cranium is nearly the same, originally, as in the Human Body. The Orbits are of great size. In some, they are separated by a Membrane; in others, by a partition more or less Osseous. The Temporal Bones have no Zygomatic Processes. The Cranium, in the whole of the class, is joined to the Bones of the Neck, by a single hemispherical Condyle, placed at the fore part of the Foramen Magnum.

The relative magnitude of the Cranium and Jaws varies much in Birds. In some, as the *Owl*, the Bill bears a small proportion to the large Cranium; in others, as the *Rhinoceros Bird*, it is of an extraordinary size. The Nasal and Palatine Openings also vary much in different Birds; in the *Stork*, they are small; in the *Crane*, remarkably large.

The Upper Jaw, or Mandible, in most Birds, is more or less moveable. It either constitutes a particular Bone articulated with the Cranium, as in the *Parrot* kind, or is united with it into one piece, by means of elastic Bony Plates, as in Birds in general. It is immoveable in a few, as in the *Cock of the Wood*, and the *Rhinoceros Bird*.

The *Teeth* are wanting in the different individuals of this class, the Bill supplying their place, yet acting like the Fore-teeth of those Animals that use them for seizing their prey.

All Birds have a Bone termed *Os Quadratum*, by which the Lower Jaw is articulated with the Cranium on both sides. Another small Bone is connected with it, and rests by its opposite end against the Palate, in such a manner as to elevate the Upper Jaw when the Square Bone is carried forwards by its Muscles.

The *Os Hyoides* is divided, as in Mammalia, into a Body and two Cornua, which are of a round and slender form.

The number of the *Vertebræ* is as variable as in Quadrupeds. In the Neck, they are numerous, and vary more than in the other parts of the Spine, the number depending upon the length of the Neck. The smallest number of Cervical Vertebræ is found in the *Sparrow*, and the greatest in the *Swan*, the one having only nine, while the other has twenty-three. The Dorsal Vertebræ are fewest in the *Bull-finch*, being only six in number, and most numerous in the *Swan*, which has eleven. The Lumbar Vertebræ are united into one piece. The smallest number of Sacral Vertebræ exists in the *Coot*, there being only seven, while the *Ostrich* has twenty, which is the greatest. The *Turkey* and *Pheasant* possess the smallest number of Caudal Vertebræ, viz. five. The greatest number is found in the *Starling*, *Swallow*, and *Ostrich*, which have nine.

Each of the Bodies of the Cervical Vertebræ forms a part of a Cylinder, in consequence of which, they are allowed free motion.

The three or four uppermost Vertebræ can only move forward, and the rest backward, the whole giving the form of an *f*; but by contracting or widening the two Arches,

Arches, they can shorten or lengthen the Neck readily. The Atlas has the shape of a ring, and is only connected with the Head by a single articulation in the form of ball and socket. From the whole of this structure, such motion is allowed, that Birds have the peculiar power of placing the Bill under the Wing when they rest.

The Dorsal Vertebræ have the Spinous Processes tied together by strong Ligaments, and they are often united into a solid mass. The Transverse Processes send off two points, one forwards, the other backwards, which join those of the other Vertebræ, and the parts here are sometimes also anchylosed; but in Birds that cannot fly, as the *Ostrich* and *Cassowary*, the Vertebræ remain moveable.

The Lumbar Vertebræ are commonly ossified together, and also to the Bones of the Sacrum and Pelvis, so as to give the appearance of a single Bone. The two lateral parts of the Pelvis do not close before, to form a Symphysis Pubis, excepting in the *Ostrich*. There is generally a Foramen Thyroideum, and the Ischiatic Notch is formed into a complete Foramen.

The Caudal Vertebræ are found in greatest number in Birds which move their Tail most freely, as the *Magpie* and *Swallow*. The last Vertebra of the Tail is the largest, and is often in form of a plough-share, for the attachment of the Quills. In the *Peacock*, it is of an oval form, and situated horizontally.

The *Thoraæ*, in Birds, is commonly remarkably large in proportion. The Ribs have several peculiarities in their form and attachments. Their Vertebral Extremity

Extremity is forked, one of the Branches resting upon the Body of the Vertebra, the other upon its Transverse Process. The Sternal Extremity has an Osseous Appendage supplying the place of Cartilage. The middle of the Rib has a flat Process directed upwards and backwards over the following Rib, each in this manner supporting the other. The number of the Ribs is less than in the Human Body; they are not found to exceed ten pairs.

The *Sternum* is of great proportional size, covering not only the Breast, but a large part of the Belly. Internally it is concave, externally convex, and is extended below into a ridge termed *Crista*, resembling the keel of a ship. This, with the under surface of the Bone in general, serves for the attachment of the very strong Pectoral Muscles, that move the Wings. In some Birds, as the *Ostrich* and *Cassowary*, which have not the power of flying, the Sternum is flat below, and there is no Crista.

The *Wings* are connected to the Sternum by three Bones, viz. two *Clavicles*, and the *Furcula*, *Fork-like Bone*, or *Merry-thought*. The Clavicle is articulated with the anterior edge of the Sternum, and has little motion. It is divided into two short processes, one connected to the Furcula, the other to the Scapula, with which it forms a Cavity for the reception of the Humerus. The Furcula is remarkable in Birds, and is seldom wanting. It is in form of a V, common to both Shoulders, and is joined by its point to the most prominent part of the Crista of the Sternum, while the other extremities are connected to the Humeral end of the

the Clavicle, and the point of the Scapulæ, where these two Bones are articulated with each other, and with the Os Humeri. The Furcula serves to keep the Wings at a proper distance in flying, and is strong and expanded in Birds which fly with great force and rapidity. In the *Ostrich* and *Cassowary*, it is imperfect, the lateral Branches not uniting together.

The edge of the Scapula, in Birds, is long next the Vertebræ, and the Bone is always destitute of a Spine.

The Wings, or Superior Extremities, consist commonly on each side of an Os Humeri—two Bones of the Fore-arm—two of the Carpus, one of which is Radial and Rhomboidal, the other is Ulnar, wedge-shaped, and has a Tubercle, which is sometimes a separate piece, corresponding with the Os Pisiforme in Mammalia—two generally consolidated into one piece in the Metacarpus—one in the Thumb—two Fingers, that next the Thumb long, consisting of two Portions, the other has only one. The Os Humeri is articulated with the Clavicle and Scapula, and below has two Articular Processes, as in Man. The Radius and Ulna move freely on the Os Humeri; but the Radius cannot turn upon its own axis. Upon the First or Long Finger, and the Metacarpal Bone, the Primary Quills are placed. The Thumb sustains the False or Bastard Quills.

The size of the Bones of the Wings varies as occasion requires. In Birds of prey, which have to carry their Food frequently to a considerable distance, and others which fly far, the Bones of the Wings are of great length; while in domestic Fowls, &c. these Bones are small in proportion to the size of their Bodies.

The

The Bones in the Wings of the *Penguins* are remarkable for their flattened appearance, and form a sort of medium between the Wing of the Bird and the Fin of the Fish.

In the Lower Extremities, there is an Os Femoris, a Tibia, and a Fibula, which is soon anchylosed to the Tibia, and does not reach its Lower Extremity; a Rotula, the place of which is often supplied by a Process of the Tibia, as in Diving Birds; one Bone supplying the place of Tarsus and Metatarsus; and the Toes, the Bones of which are more numerous, the more exteriorly they are placed. The Toes are articulated upon a Pulley, formed by the lower end of the Metatarsal Bone. The inner side has a small Bone, that supports the Posterior Toe or Pollex. There are two Bones to the Pollex, three to the Second Toe, four to the Third Toe, and five to the Fourth. In Birds with only three Toes, the First Toe has three, the Second four, and the Third Toe five Bones. The *Cassowary* has only three Toes, and the *Ostrich* two. The Birds with four Toes have commonly three before, and one behind. Some, as the *Parrot*, *Cuckoo*, &c. have two before and two behind. Swimming Birds, as the *Penguin*, have the Pollex obliterated.

In wading and other long-limbed Birds, the length of the Leg is produced by the Tibia, and the Bone which supplies the place of Tarsus and Metatarsus; and is often in proportion to that of the Neck, though there are many exceptions. The Lower Extremities of Birds in general, are placed so much behind the common centre of gravity, as to make the Animal appear

pear to be in danger of falling forward in walking; but this is prevented by the angle formed between the Leg and Body, and by the elevation of the Head and Neck.

OF THE MUSCLES.

THE *Muscles* of Birds are peculiar, in having their Tendons converted into Bone as the Animal becomes old.

Of the Mucles of the Head, there are three in each side, which serve instead of the Digastric for depressing the Lower Jaw. They are distinctly seen in the *Duck*, but one of them is frequently wanting in other Birds. There are three, also, for closing the Bill, one of which supplies the place of the Temporal and Masseter, the other, that of the two Pterygoid Muscles. The Os Quadratum has three pairs on each side, which assist also in the opening and shutting of the Bill.

In the *Turkey*, the Os Hyoides has Muscles analogous to the Mylo-hyoid, Stylo-hyoid, Stylo-glossus, Genio-hyoid, and Cerato-hyoid, for acting upon this Bone and the Tongue. The Tongue has three pairs fixed into it, which arise from the Os Hyoides. There are no Muscles peculiar to the Pharynx; it has Muscular Fibres common to it and the Esophagus.

The Splenius and Obliquus Superior are wanting, but

but there is an additional Rectus Posticus, viz. a Maximus.

The Muscles of the Dorsal part of the Spine are also wanting, the parts here being quite rigid. The Neck is furnished with a number of Muscles, corresponding with the number of the Cervical Vertebræ. The Tail has Muscles for raising, depressing, and turning it to either side. They arise chiefly from the posterior part of the Trunk of the Body, and are fixed to the Os Coccygis. The Lateral Muscles in particular, acting together, expand the feathers in the Tail, so as to produce that beautiful fan-like appearance, so remarkable in the *Turkey*, *Peacock*, and *Pheasant*.

Of the Muscles of the Ribs, the Scalenus is analogous to the Levatores Costarum, which extend from the transverse processes of the Vertebræ, to the anterior edges of the Ribs. The Intercostales and Triangulares bear a considerable resemblance to those in Man. Birds have no Diaphragm. There are three Layers of Abdominal Muscles, the two outer of which run more in a transverse direction than in the Human Species. The Recti and Pyramidales are wanting.

Muscles of the Superior Extremity.—The Muscles of the Scapula are the same in number with those in Mammalia; but the Trapezius and Rhomboides are small, their origin being chiefly confined to the Spine of the Back. Birds have three Pectoral Muscles, all arising from the very large Sternum, and fixed to the Scapulary extremity of the Humerus. The First, or Great Pectoral, with its fellow, which weighs more than all the other Muscles taken collectively, arises from the Os Furciforme,

Furciforme, the Keel of the Sternum, and the last Ribs, and is inserted into a prominent Linea Aspera of the Os Humeri. By depressing this Bone, the Muscle produces the quick and powerful motions of the Wing in flying. The Second, or Middle Pectoral, is situated under the former, and sends a Tendon over the union of the Scapula, Furcula, and Clavicle, as over a pulley, to elevate the Humerus, and balance the Animal in its flight. The Third, or Smallest Pectoral, arises from the lateral angle of the Sternum and base of the Clavicle, and brings the Humerus close to the Body, in which motion it is assisted by two small Muscles, passing between the Clavicle and Head of the Humerus. By the action of these three Muscles, the alternate motions of raising and depressing the Wing are produced, by which the Bird is carried forward in flying. By the strength of the Tail the Animal is kept in a proper balance, and prevented from falling forward.

The Latissimus Dorsi is formed of two portions, one fixed under the Head, and the other at the middle of the Body of the Humerus. The other Muscles of the Scapula are nearly as in the Human Body.

The Biceps has one origin from the Scapula, and another from the Os Humeri, and is inserted into the Ulna. The Bracheus arises from the Linea Aspera, and is fixed to the inner side of the Head of the Ulna. There is another Flexor which arises from the External Condyle of the Humerus, and, after extending some way along the upper portion of the Ulna, is fixed to the outer part of that Bone. The Extensor Cubiti is composed of two portions, one from the Scapula, the other

other from the Humerus. There is also an Anconeus. The Supinator Longus is wanting. There is a kind of Supinator Brevis, but it is considered as bending the Fore-arm. Two Muscles occupy the place of the Pronator Teres, though seemingly acting as Flexors.

The Metacarpus possesses only the motions of adduction and abduction. The Muscles for performing these motions are the following: The Ulnaris Internus, which arises as in Man, and is fixed to the wedge-like Bone of the Carpus; another Muscle lying under this, and sending off a long Tendon, which gives slips to the secondary Quills, and is inserted to the back of the Metacarpus; the Ulnaris Externus, which is placed on the posterior surface of the Ulna; its Tendon, passing between the last Primary Quill, and first Secondary one, and fixed to the inner edge of the base of the Metacarpus; a Radial Muscle, which arises by different portions from the External Condyle, and one from the Radius, their common Tendon being fixed to the Tubercle of the Metacarpal Bone of the Thumb.

The Digital Muscles, also, can only perform adduction and abduction. Of the Adductors or Extensors, there is the Adductor Phalangis Primæ, which corresponds with the Flexor Sublimis, arises from the Internal Condyle, and is fixed to the base of the first Bone of the Great Finger. The Adductor Internus Phalangis Secundæ, which corresponds with the Flexor Profundus, and goes along the inner side of the Radius, and is inserted into the base of the second Phalanx. The Adductor Pollicis, which corresponds to the Flexor Pollicis, is situated between the

the preceding Muscle and Ulna, and sends a Tendon to be fixed to the radial edge of the Thumb. The Adductor Externus Phalangis Secundæ, which is analogous to the Flexor Proprius Indicis, arises from the External Condyle, having its Tendon fixed to the back of the Metacarpus and second Phalanx of the Great Finger.

Muscles of the Pelvis and Inferior Extremity.—The Psoas Parvus and Magnus, the Iliacus Internus, and Quadratus Lumborum, are wanting. There are two Adductor Muscles of the Thigh, situated as in Mammalia, and a Muscle analogous to the Pectineus, which is continued to join the Flexor Perforatus of the second and fifth Toes. The three Glutei have the same proportions as in Quadrupeds. The Pyriformis and Gemini are wanting. The Muscle analogous to the Quadratus Femoris is remarkable for its great size. The Obturator Internus goes over the Hole analogous to the Foramen Thyroideum. The Extensors of the Leg are nearly as in Quadrupeds. Of the Flexors, there are two somewhat analogous to the Biceps and Semi-membranosus; a third which is intermediate, but is sometimes wanting, particularly in Birds of prey; and a fourth, which forms the anterior part of the Thigh, and is similar to the Sartorius. The Tendons of the Gastrocnemii remain separate to near the Heel. The Soleus is fixed to a Linea Aspera, which belongs to the Tibia. There is a Peroneus Brevis, and a Muscle analogous to the Peroneus Tertius in Man.

There is an Extensor Longus of the three Anterior Toes, corresponding to the Extensor Longus

Digitorum. The Extensor Longus Pollicis is wanting; four small Muscles supply the place of the Extensor Brevis; a Flexor Brevis Pollicis is situated in the back part of the Tarsus. There are long Flexors of the Toes, which are divided into three masses; these come partly from the Os Femoris, and partly from the Bones of the Leg. They have connected to them an Accessory Flexor, which comes from the Pubes, and sends a Tendon over the Knee. The different Tendons run under the Heel, and are united by Fibres to each other; and one set of Tendons perforate another, and are fixed to the different Phalanges of the Toes. By this mechanism, the Bird is supported, or can lay hold of Branches of Trees, &c. when roosting; the weight of the Body giving that degree of flexion to the Knee and Heel, which produces the necessary contraction of the Toes. By this contrivance, also, Rapacious Birds seize their prey while pouncing on it. When they wish to disengage themselves, they do it readily by raising the Body, after which the Toes are expanded.

OF THE INTEGUMENTS.

The *Integuments* consist of the same parts as in Mammalia. The *Cuticle* is very thin, and, in the Legs and Feet.

Feet, is generally formed of Horny Scales, which fall off in moulting-time.

The *Corpus Mucosum* is not very distinct. It varies in colour in different parts of the Body. In the Legs and Feet, almost all the different colours are to be observed in the different individuals of the class.

The *Cutis* is much thinner than in Quadrupeds, but has considerable thickness in Birds of prey. The Papillæ Nervosæ, and sense of feeling in the Integuments of Birds, reside only in the Feet and Toes, the Superior Extremities being generally covered with Feathers. Even in the Lower Extremities of some, the Legs and Toes are frequently covered with Scales or Feathers, so as to blunt the sense of Feeling also in this part of the Animal.

The *Cellular Substance* immediately under the Skin, adheres loosely to the parts directly above and below it, but particularly at the Axillæ.

In certain Birds, as the *Swallow*, the Subcutaneous Cellular Substance is deprived of Fat, though the Peritoneum is charged with it in the winter-season.

From the surface of the Skin, *Excretions* take place, as in the former class of Animals, as appears in moulting, and from a quantity of mealy dust being separated in pairing-time.

Besides the Layers of the Skin mentioned above, Birds have a *Panniculus Carnosus*, which is more distinct in certain kinds, as those which raise their Feathers in particular parts of the Body. Besides one broad Muscle, there are *Slips* which run in different

directions, and act upon the Skin and Feathers over them.

The *Feathers* are the peculiar covering of Birds. They protect them from the inclemency of the weather, and serve them for flying. In Water Fowls, the Feathers are besmeared with an oily fluid, which prevents the water from injuring them.

Upon certain parts of the Integuments there are *Glands*, that separate an oily matter, with which they anoint their Feathers. These are found under the Skin of the crop; but the greater part of this substance is discharged, by one or more orifices, from a Gland situated upon the Rump. With the contents of this, the *Duck*, by means of the Bill, frequently besmears the Feathers.

The Feathers are wanting in young Birds. When they first leave the Egg, they are covered with *Hair*, formed into Fasciculi, each of which grows from a common Bulb, that gives origin to the future Feathers.

The Hair is soon succeeded by *Sheaths*, giving passage to the Feathers, the inner ends of which are supplied with Blood-vessels, that form first the *Barrel*, then the *Stalk* of the Quill.

The inner part of the Feathers is at first composed of a Pulpy substance, inclosed in Cells. The Pulp is by degrees absorbed, and the part assumes the appearance of a Corpus Cavernosum. The Stalk is convex on one side, and concave, and furrowed in the middle, on the other. Upon the sides of the Stalk are *Barbes*, composed of Horny Laminæ, and beset laterally with Hairs or Barbules. The Feathers on the Wings and Tail are termed

ed *Pens* or *Quills;* those on the Bones, analogous to the Fore-arms, are termed *Secondary.*

The Feathers vary exceedingly in appearance in different Birds. Some, as the *Turkey*, *Raven*, &c. are covered with Hairs in particular places. The Feathers of Night Birds of prey are covered with down, while those of other Birds are garnished with a kind of silk. Some Birds have Feathers not only on their Bodies, but also on their Feet; and some, as the *Moor Game*, have them on their Feet in the winter season only.

Some, as the *Vulture* and *Turkey*, want them on the Head. Several have two or more Feathers arising from a common Quill.

In the *Penguin* kind, the Feathers of the Wing are in the form of small Scales. In the *Cassowary*, they are like the Quills of the *Porcupine*, being destitute of Barbules.

The Feathers of Birds are annually changed, or there is a moulting-season; but all Feathers are not found to fall at the same time.

In several Birds, where the Male and Female have different Plumage, it is observed that the latter, after ceasing, through age, to lay Eggs, assumes the Plumage of the Male.

Birds have Claws commonly on the Toes; and in Birds of Prey, they are strong, like those of Carnivorous Quadrupeds.

In Gallinaceous Birds, there is a supernumerary Claw, the *Spur*, which the Animal uses in fighting, and in fixing upon the Female in discharging the Semen. The *Ornithorrynchus* has a Spur for the same

purpose. In the former Animals, the Spur has one Bone in it, which is fixed to the Tarsus; in the latter Animal, it has two.

Claws are wanting in the Wings of Birds, where they could not be used, either for walking, or seizing the prey.

OF THE BRAIN, &c.

THE *Membranes* of the Brain correspond, in number and general appearance, with those of the former class. In some Birds, there is even a *Falx*, and this, in the *Wood-cock* and *Ornithorrynchus*, is of an Osseous nature.

The proportional *size* of the *Brain* of the Animals of this class varies extremely; but it is found, that the Brain of the smaller Birds bears a greater proportion to the size of the Body, than that of the larger kinds. While, in the *Sparrow*, it is a 25th, and in the *Gold-finch*, a 14th of the weight of their Body; in the *Eagle*, it is only a 160th, and in the *Goose*, a 360th.

The Brain consists of two large masses, which form the Hemispheres, the two Thalami Optici, the Cerebellum, and Medulla Oblongata.

The *Hemispheres* are in form of a Heart, with the base turned backward. There are no Convolutions, nor Corpus Callosum, nor Fornix, nor Septum Lucidum.

cidum. The Corpora Striata are of uniform colour internally.

The *Thalami* are two roundish Tubercles lying under the Hemispheres, without being inclosed by them. Between the Thalami and Corpora Striata are commonly four Eminences, which do not appear in Man. The *Lateral Ventricles* do not turn down behind to form the inferior Cornua; of course, the Cornua Ammonis are absent. The Lateral Ventricles, in Birds, are distinguished from those of all other Animals, by the radiated partition which separates them from each other. They communicate with each other, and with the Third Ventricle.

The *Third Ventricle* is situated between the Thalami, and communicates with the Infundibulum, and also with the *Fourth Ventricle;* but the passage into this last is only covered by a thin Lamina, the Tubercula Quadrigemina being either absent or indistinct, though the Pineal Gland is present.

In each of the Optic Thalami, there is an *additional Ventricle*, which opens into the passage leading from the Third to the Fourth Ventricle.

The *Cerebellum* is only a simple Lobe; it has, however, transverse Striæ, somewhat similar to those in Mammalia. The Fourth Ventricle has also, as in that class, a Calamus Scriptorius, and an Arbor Vitæ; but the latter is more simple than in Mammiferous Animals.

The *Pons Varolii* is wanting. The Medulla Oblongata has no Eminences, such as are seen in the former class of Animals.

Nerves.

The *Cerebral Nerves* are the same in number as in Mammalia. The *Olfactory*, after leaving the Brain, goes in a distinct Canal to the Cavity of the Nose. The *Second* crosses its fellow, and goes to the Eye of the opposite side. The *Third*, either by a hole peculiar to it, or by a Sphenoid Fissure, passes to the Muscles, as in Mammalia. The *Fourth* is also as in the former class. The *Fifth* divides as in Mammalia. The Branches to the Beak correspond with those about the Jaws in Mammiferous Animals; but those to the inner side of the Nose are of great magnitude, and run to the extremity of the Bill, in Birds which search for their food in water, mud, &c. The *Sixth* are as in Mammalia. Of the *Seventh*, the *Portio Dura* is proportionally small, the Lips being absent, and much of their Bill being Horny and Callous, and not requiring a great supply of Nerves. The *Portio Mollis*, of great size, goes to the Labyrinth by many Branches. The *Eighth* and *Ninth* pairs are dispersed as in Mammalia.

The *Great Sympathetic* has origins, connexions, and terminations, which bear a considerable analogy to those of the Animals of the former class, varying only in some particulars. It passes through the same Foramen with the Pars Vaga and Glosso-pharyngeus. It unites with Nerves near it, has Ganglia in its course through the Body, and can be traced as far as the Vertebræ of the Tail.

The *Spinal Marrow* is nearly of the same nature, and the

the Nerves are generally sent off from it by anterior and posterior bundles of Fibres, as in Mammalia.

The *Cervicals* are analogous to those of the former class of Animals, but the number corresponds with that of the Vertebræ. They go chiefly to the Neck, only one or two of the last assisting in the formation of the Brachial Plexus.

The *Diaphragmatic Nerves*, like the Diaphragm itself, are wanting.

The *Dorsals* and *Lumbars* correspond with those in Mammalia, and the number with that of the Vertebræ.

The *Brachial Plexus* is chiefly formed by the last Cervical and two first Dorsals, and is large, having to supply the Pectoral Muscles of great size, which are inserted into the Wings.

The Nerves of the *Abdominal* or *Inferior Extremities* are nearly as in Mammalia. The Anterior Crural is sent off from the three last Lumbars, from which also the Obturator comes. The Sciatic is chiefly formed by the four Superior or Anterior Pelvic Pairs, and divided somewhat as in Mammalia, the last Branches dividing into others according to the number of the Toes.

OF THE EYE.

THE *Eyes* are larger in the individuals of this class, in proportion to the size of the Scull, than in Mammalia, and

and are placed so much in a lateral direction, that the Animal, in viewing objects particularly, turns towards them one side of the Head, and examines them with a single Eye.

The *Orbits* are more shallow here than in Quadrupeds, of course, the cushion of Fat surrounding the back part of the Eye is thinner.

In most Birds, as *Fowl*, *Duck*, *Turkey*, &c. the *Eye-lids* are closed by the Orbicularis elevating the Inferior Palpebra, which is the largest, and has a small Lamina of Cartilage. There is a *peculiar Muscle* arising from the bottom of the Orbit, for depressing this Eye-lid.

In a few, as the *Parrot*, *Owl*, *Goat-sucker*, *Ostrich*, &c. the Upper Eye-lids are most moveable.

Cilia are found in a few Birds only, as some *Parrots* and *Hawks*, the *Ostrich*, &c.

Besides the two ordinary or horizontal Eye-lids, Birds have a third one placed at the Nasal Angle, and termed *Membrana Nictitans*, which is a semi-transparent Membrane, capable of covering the whole Eye. In a state of rest, it is scarcely observed, but can be drawn out by the action of two Muscles, so as to cover the whole front of the Globe. The Muscles performing this motion, arise from the back of the Sclerotic. The one, termed *Quadratus*, has its origin from above; the other, called *Pyramidalis*, comes from below, and forms a Tendinous Cord, that runs through an Aponeurotic Sheath formed by the first, then in Cellular Substance at the under part of the Sclerotica, to be fixed to the inferior and exterior edge of the Membrana Nictitans.

After

After the Membrane has been drawn to the outer corner of the Eye, it is returned by its own elasticity.

The *Lacrymal Gland*, in Birds, is commonly small. It is situated at the outer angle, and sends out the Tears in some, as the *Common Fowl*, by one, and in others, by two or three small Canals, through the Upper Eye-lid.

The *Glandula Harderi* is also found here; it is of a fleshy colour, and considerably larger than the Lacrymal Gland. It is commonly placed between the Levator and Adductor Oculi, and discharges, by a single Duct, a yellowish fluid upon the inner surface of the third Palpebra.

In the *Duck* tribe and the *Water Birds*, there is a *large Glandular Body* in the upper part of the Orbit, which seems to supply the place of the Lacrymal Gland, yet no Duct has been traced from it.

All Birds have two *Puncta Lacrymalia*, but no *Caruncula Lacrymalis*. The passages from the Puncta terminate in the Nasal Sac, situated in the Palate, at the base of the Nose.

The *Sclerotic Coat* forms little more than a hemisphere in this class, and to its anterior flat part is attached the Cornea, making a section of a smaller globe. In consequence of the flatness of the anterior part of the Eye, it is prevented from being injured when the Animal is scrambling among bushes, or taking a rapid flight through the air.

The fore part of the Sclerotis divides into two Laminæ, between which there are numerous Osseous Plates, which overlap each other, and form a Ring, commonly flat,

flat, but sometimes convex, at other times, as in the *Owl*, concave.

The *Choroid Coat* has no *Tapetum*, such as is found in many Quadrupeds. The inner side is uniformly blackish, and lined with *Mucus*, which prevents Birds from seeing distinctly in the dark.

All Birds have *Ciliary Processes*, but they project so little, that they appear rather like Striæ than loose Folds, and are connected to the Crystalline Lens.

The boundary between the Choroides and Iris is distinctly defined in this class.

The *Iris* varies in appearance according to the Species. It is blue, red, or yellow, and commonly possesses great brilliancy.

In some, as the *Parrot*, the motions of the Iris are voluntary. The Animal can dilate or contract the Pupil at pleasure. A *Membrana Pupillaris* is not observed in Fœtal Birds.

The *Optic Nerves* run here in such a manner, that it is difficult to distinguish any union in them. Upon reaching the Ball, each goes through a Sheath of the Sclerotic Coat, and then forms a round white line, from which grows the *Retina*.

In the internal part of the Eye, there is a Membrane of a most delicate texture, somewhat resembling the Choroid Coat, and termed *Marsupium Nigrum*, *Pecten*, or *Membrana Plicata*, from its colour and plaited appearance. It arises in the bottom of the Eye, at the entrance of the Optic Nerve, passes obliquely through the Retina, and terminates at or near the edge of the Crystalline Lens. It is formed of Plicæ, varying in number

number in different Birds, and is of a conical form, very Vascular, and covered with a black paint. In the *Ostrich* and *Cassowary*, it forms a kind of conical purse, whence the French term it *Bourse Noire*. It is supposed to absorb rays of light when too strong, or when the Animal attempts to look at near objects. And some have considered it as serving to move the Lens; but Muscular Fibres have not been detected in it, and its oblique situation is also unfavourable to this.

The *Humours* of the Eye are analogous to those in the former class. The *Lens* is flatter or rounder, in an inverse ratio to that of the Cornea. In *Land Birds*, it is flat, as in Mammalia; in the *Aquatic*, it is more of a globular form.

The *Muscles* of the Eye, in Birds, are the same in number as in the Human Body; but both the Obliqui come from the fore part of the Orbit, near each other. One is inserted below, the other above, without going through a pulley, as in Mammalia. The whole Muscles of the Ball are fixed to the soft part of the Sclerotic, behind the Osseous Laminæ, and are shorter in proportion than in the former class. This, together with the flat shape of the Ball, allows very little motion. The Suspensory Muscle existing in Quadrupeds, is wanting in Birds.

OF

OF THE EAR.

There is no Cartilaginous *External Ear* in any of the class, but instead of it, especially in Rapacious Birds, there is a *Tuft* of *Feathers* regularly arranged round the External Meatus, which excludes dust, insects, &c. but allows sound to enter readily.

In the *Owl* kind, and several others, chiefly Birds of prey, there is a *Membrano-muscular Valve* over the passage, which has been compared to the Concha of the Human Ear. The edges of this have a number of slender Feathers placed in a circle, which gives a singular appearance to the Animal.

The *Meatus Externus* is little else than a simple hole in the surface of the Scull. It has a liquor secreted in it, which may answer the same purpose as the wax of the Ear of Mammalia.

The *Membrana Tympani*, contrary to what happens in the former class, is convex outwardly, and of an oval form, with the long diameter placed downwards and forwards.

The *Tympanum* is of considerable size, and has within it only one *Ossiculum Auditus*, which is rather of a Cartilaginous consistence, and termed *Quadratum* from its shape. It is composed of two Branches, which form a kind of Elbow. One is attached along the inferior half of the Membrana Tympani, the other goes from the superior part of the former, at the middle of the Membrana Tympani, and divides into slender Crura,

Crura, which unite again in a plate that fills the Fenestra Ovalis.

There is only one Muscle belonging to the Square Bone. It is situated in the Occiput, behind the Ear, and, penetrating the walls of the Tympanum, is so fixed to this small Bone, as to stretch the Membrana Tympani.

The *Eustachian Tube* is conical, and entirely Osseous. It runs from the Tympanum to the Palate, where it terminates by an opening common to it and its fellow, behind the Internal Nares.

Of the two Foramina by which the Tympanum communicates with the Labyrinth, the Fenestra Rotunda is the larger, contrary to what happens in Mammalia.

The Tympanum, in many Birds, particularly in the *Owl*, communicates with three large Cavities inclosed in the Osseous Plates. These again communicate by an equal number of openings with the Tympanum in the same side, while one extends over the Occiput to its fellow on the other side, and another goes under the Pituitary Gland to the corresponding one on the opposite side.

In night Birds of prey, these Cavities are very large. In those which seek their prey in the day-time, and in the *Gallinacea*, they do not communicate on the opposite sides of the Head. In Aquatic Birds, they are generally small. In *Parroquets*, they have not been discovered.

The *Labyrinth* is distinguished by the Semicircular Canals projecting from the base of the Cranium, and in such a manner, that, in many Birds, they are visible without

without any preparation, on account of their not being inclosed by an Os Petrosum, as in Mammalia.

The *Semicircular Canals* are peculiar, by two of them crossing, and communicating with, each other. They are larger in proportion than in Mammalia, and larger in Birds of prey than in others; but the Vestible, in Birds, is proportionally small.

In place of a *Cochlea*, there is a conical Bone, bent a little, and obtuse at its extremity. It passes off from the Vestible, and is divided, as in Mammalia, by a partition into two Scalæ, which communicate with the Tympanum and Labyrinth as in Man. This, with the other parts of the Labyrinth, receives the Portio Mollis, as the Cochlea does in the former class of Animals.

OF THE NOSE.

THE *Organ* of *Smell* is proportionally large, and its acuteness is shewn in Birds of prey, which discover their Food at a considerable distance.

The *Nostrils* vary in situation, size, and form, in different Birds. In some, they are found at the side of the Beak, in others, at its base; and are placed opposite to an opening in the Septum, in consequence of which, there is a free communication between the opposite

site sides of the Bill. In some individuals, they are so small as to be scarcely perceptible.

They have neither moveable Cartilages nor Muscles, but are formed of Laminæ covered by the Skin, which is expanded over the Beak.

There is no proper Ethmoid Bone in Birds, though they have distinct *Ossa Spongiosa*, which divide the Cavity of the Nose into different Meatus.

The *Membrana Pituitaria* is plentifully supplied with Vessels, which furnish abundance of Mucus.

The *Internal Nares* commonly open by one chink upon the Palate, which is beset with soft pointed Papillæ, turned backward, and furnished with Muscles, by which it can be shut at pleasure.

The *Palatum Molle* is wanting.

The *Foramina Incisiva* vary in number, size, and situation, in different Birds. In some, there is but a single opening, which is large; in others, there are more, but small. In some, it is placed near the point, in others, at the base of the Bill.

The Nose, as in the former class of Animals, is copiously furnished with Nerves; the Olfactory come from the fore part of the Anterior Lobe of the Brain, and pass along a Canal, after which they form innumerable Fibrillæ, dispersed upon the Membrana Mucosa.

In Water Fowls, particularly in the *Duck* tribe, the Nerves of the Nose, viz. the Olfactory, and a Branch of the Fifth Pair, are uncommonly large, and can be easily traced to the end of their Bills; in consequence of which, they are enabled to search for their Food in water, mud, &c.

OF THE MOUTH, THROAT, AND THEIR APPENDAGES.

The part supplying the place of Teeth, in Birds, is the *Rostrum*, or *Bill*, which is formed of a Horny Substance similar to the Claws and Spurs, and moulded upon the Osseous part of the Jaws.

The form and texture of the Bill correspond with the habits and food of the Animal. In Rapacious Birds, as the *Eagle*, the Bill is hard and hooked at the end, for seizing and lacerating the prey. It is also of a very firm texture in Birds that bruise hard seeds. In those which live upon softer Food, it is more delicate; and in such as the *Duck* kind, which search for their food in water or mud, it becomes soft and remarkably sensible.

Many Birds, particularly in the orders *Accipitres* and *Gallinæ*, have a soft Skin covering the base of the Bill, which gets the name of *Cire*, (wax), the use of which is not yet ascertained.

Tongue and Salivary Glands.

All Birds are furnished with a Tongue, the form and structure of which vary much in different Genera and Species. It has Papillæ of different forms, some fleshy, soft, and rounded, others Cartilaginous, and placed on its

its root, and also on the Palate, to prevent the Food from escaping after it has entered the Mouth.

Some *Predaceous* and *Swimming Birds*, and most of the *Parrot* kind, have a soft Tongue, covered with Papillæ, and moistened with Mucus, to enable them to select proper Aliment. In the *Parroquet*, it is fleshy, very thick, and rounded before. *Nocturnal Birds of Prey* have it also fleshy, with soft Papillæ turned backward.

In the *Gallinacea*, the Tongue is triangular, pointed, smooth, Cartilaginous, and destitute of Papillæ, excepting at its root; its firmness preventing it from being injured by the hard and pointed substances upon which they live.

In the *Duck* kind, it is fleshy and large, but in several of these, it is furnished with ranges of Osseous Laminæ; and almost all the kinds have rigid Hairs upon the sides.

In the *Swan*, it is covered with stiff Hairs, Osseous Plates, and Fleshy Papillæ; and some of these substances are directed backward. In many, as the *Toucan*, the Tongue is of a Horny consistence, like a piece of Whale-bone; in the *Pic*, it is forked, or divided into two parts; in the *Ostrich*, of a semilunar form, and remarkably short; in the *Pelican*, so short, that its existence has been by many denied.

The nature of the Tongue is more remarkable in the *Wood-cock* and *Wood-pecker*, than in many other Animals of this class. In the *Wood-cock*, the Tongue, and also the Larynx, are placed deep in the Esophagus, and the former can be elevated by Muscles peculiar to it.

The Tongue of the *Wood-pecker* is a sharp Horny substance with barbed edges, and fixed at its root to a Cartilaginous Os Hyoides, consisting of a Body and two pairs of very long Crura. The Body, when in a state of rest, is placed in a fleshy sheath of the Bill. Two of the Crura lie in the Neck, the other two are connected to the former, then proceed completely over the Cranium, running under the Integuments, and are fixed to the Upper Jaw. By means of this apparatus acting like a spring, the Tongue can be thrust some inches out of the Mouth.

The *Salivary Glands*, in Birds, exist only under the Tongue, where they occupy the place of the Sublingual in Mammalia. They form a mass of small Granulous Bodies, from which a liquor, somewhat Viscid, flows into the Mouth by numerous orifices.

In the *Gallinacea*, they are of considerable size. Two pairs are found in the *Turkey*, the first lying concealed immediately under the Skin, the second on the posterior portion of the first. Their colour is yellowish, like the humour which they secrete. In the *Parroquet*, the liquor of these Glands is viscid and grey. In the *Wood-pecker*, the Salivary Gland extends as far as the Occiput, is of a white colour, and sends out a single Duct, which terminates under the point of the Tongue, discharging a white Fluid into the Mouth.

Water Birds in general have but one pair of Glands, which secrete a white and viscid humour, discharged by many orifices; but in some of the Birds of this order, as the *Gull*, the Salivary Glands have only a single Duct.

OF

OF THE HEART AND BLOOD-VESSELS.

THE *Heart* corresponds in its principal parts with that in Mammalia. It has four cavities, which have the same general appearance, and transmit the Blood in the same manner. It is of a conical form, but the cone varies in length or in roundness in different Birds. The situation is nearly the same as in Mammalia, but nearer the anterior part of the Thorax.

The *Pericardium* is covered by the Membrane formed by the Pleura and Peritoneum.

The *Auricles* have no Appendices externally. The *Ventricles* have Columnæ Carneæ in proportion to their thickness and strength. The *Valve* corresponding with the Tricuspid in Mammalia, is peculiar, in being formed of a strong fleshy flap, while the other Valves resemble those in the former class.

The *Pulmonary Artery* is proportionally small, the Lungs occupying less space.

The *Aorta* divides near its origin into three smaller Aortæ. The right forms the Posterior or Descending Aorta, the other two form the Subclavian Arteries.

The *Subclavians* give off the Carotids, Vertebrals, Branches to the Neck and Thorax, then divide into Radial and Ulnar, which are dispersed on the Wings.

The Radial is proportionally small; the Ulnar very large, runs along the external edge of the Wing.

The *Posterior Aorta* sends off the *Cœliac* to the Stomach, Liver, Spleen, Pancreas, and part of the Intestines; then the two *Mesenterics*. It gives also the *Spermatics* to the Testes and Ovaria, and Anterior Lobes of the Kidneys; the *Intercostals* and Lumbars to the containing parts of the Body; continued farther, it furnishes Branches to the Kidneys and Pelvis, and at last to the Inferior Extremities.

The *Veins* correspond with those in Mammalia; but there are two anterior Cavæ, both opening into the upper part of the Auricle.

In the larger Birds, as the *Ostrich*, Muscular Fibres are seen in the Cavæ, particularly in the posterior one.

In *Diving Birds*, the Cava Posterior dilates at the Liver into a sort of Reservoir, somewhat similar to that in the *Seal*.

OF THE ABSORBENT SYSTEM.

TILL of late years, Anatomists have been unacquainted with the *Absorbents* of Birds, chiefly owing to the transparency of the Chyle, and the want of Mesenteric Glands. The Lymphatics are now demonstrated in Birds, as well as in Man and Quadrupeds, and the structure

ture is also the same as in the former class of Animals; but this system differs from that of Mammalia, in the Chyle being colourless and transparent, and in there being no visible Lymphatic Glands, neither in the Mesentery, nor, in general, any where else, but at the bottom of the Neck; though, in some of the larger Birds, a few Glands have been found in other parts of the Body.

The Lymphatics of Birds have numerous communications with each other, and form *Insulæ*, which are more frequent than in Mammiferous Animals.

The Lymphatics of the Inferior Extremities of the Pelvis, and of the Organs of Urine and Generation, and also those of the Chylopoietic and Assistant Chylopoietic Viscera, join about the Cœliac Artery, and form a Plexus. From this are sent out two Thoracic Ducts, nearly of equal size, which advance under the Lungs, at each side of the Spine, and go to the inner part of the right and left Jugular Veins, where they terminate a little beyond the union of these Vessels with the Axillaris.

The *Thoracic Duct* of the Left Side receives a Branch from the Ventriculus Succenturiatus and Esophagus, and likewise the Lymphatics of the corresponding wing.

The Absorbents of the Head and Neck accompany the Blood-vessels, and join near the lower part of the Neck, to form a Trunk which penetrates a Lymphatic Gland. From the opposite side of this Gland another Trunk issues, which, in the left side, terminates in the Thoracic Duct, while in the right, part of it goes to the Thoracic Duct, and part to the Jugular Vein, near the Angle which it forms with the Axillary.

OF THE ORGANS OF VOICE AND RESPIRATION.

THE Organs of Voice and Respiration in Birds differ extremely from those of other Animals.

The *Larynx* is peculiar in being double, or in there being one at each end of the Trachea.

The *Superior Larynx* is situated at the root of the Tongue and top of the Trachea, and is composed of several osseous Pieces, the largest of which is analogous to the Cricoid Cartilage. There are neither Thyroid nor Arytenoid Cartilages, nor Epiglottis, in Birds.

The *Rima Glottidis* is a simple Chink or Slit, with Muscular sides, which can merely open and close the passage, having no connection with the formation of Voice.

In place of the Epiglottis, there are, in many Birds, Cartilaginous Papillæ upon the edge of the Glottis, to prevent the Aliment from going into the Lungs. In the *Ostrich*, there is a slight elevation, which some have considered as an Epiglottis.

The *Trachea* is composed of Cartilages or of Bone, which form complete rings, and these overlap each other at their edges in such a manner, that the diameter of the Tube is not affected by any twisting of the Neck. Its form is commonly cylindrical, sometimes conical, at other times it has dilatations and contractions, as in some of the *Swimming Birds*.

The

The *Rings* of the Trachea have no visible Muscular Fibres, but only Membranes fixing them together; though in larger Birds, as the *Cassowary* and *Ostrich*, they are observed to be covered with transverse Muscular Fibres, from which it is presumed they exist in all.

The length of the Trachea varies in different Birds with that of the Neck. It sometimes differs in the two sexes of the same Species, especially in Birds of the Aquatic kind, as is observed in the *Male Wild Swan*, the *Crane*, and *Indian Cock*. In these, the Trachea makes large convolutions, partly without and partly within the Cavity of the Thorax, before entering the Lungs; yet there are no such turns in the Trachea of the *Heron*, *Stork*, *Bittern*, &c.; these, however, are not properly *Diving*, but *Wading Birds*.

The use ascribed to this structure is, to retain the inspired air, and thus furnish a sufficient supply of Oxygen to the Animal while diving in deep water in search of prey, or flying in rarified air.

These Convolutions have been compared to the windings of a French Horn, and Birds possessing such a Trachea are said to be fine singers. But this has been doubted, more especially as such a structure is not found in Singing Birds.

The under end of the Trachea, or *Inferior Glottis*, or *Vocal Organ*, is formed of tense Membranes, and appears like the reed of a musical pipe. It is contracted into a narrow chink, and divided into two openings by a slender slip of Bone, which goes from before backward. Sometimes it is formed by the angle made by the two Bronchi.

The

The Vocal Organ is furnished with Muscles from the surrounding parts, and these vary in number in different Species.

The strength of the Muscles of the Inferior Larynx, was found, by MR HUNTER, to be in proportion to that of the Voice. They appeared stronger in the *Common Cock*, but weaker in the *Capon*; and here the Animal has not the power of crowing. The Muscles of the Larynx of the *Nightingale* were found stronger than in any other Animal of the same size.

At the Inferior Larynx the *Voice* of the Animal is chiefly formed, as may be observed by cutting the Trachea across below the Superior Larynx, in a living Bird; or in a dead one, after performing the same operation, blowing in air till it distends the Body, then suddenly forcing it out again; or by cutting out the under end, with part of the Bronchi, and blowing air from the Pulmonary Extremity.

The Inferior Glottis is compared to the reed at the mouth of the wind instruments, as the Clarionet, &c. the Superior Glottis to the holes, and the Trachea to the Body of the instrument.

The *Bronchi* are formed of two Tubes, which, like the Trachea, are commonly cylindrical, but sometimes have dilatations and contractions, and are composed of Cartilaginous or Osseous Arches, the curves varying occasionally by the action of the Muscles.

The Bronchi proceed in angles more or less acute, but are never subdivided, till they enter the Lungs, after which they lay aside their Cartilaginous structure, and become entirely Membranous; but the

Swan

Swan and *Cassowary* are observed to be exceptions to this last circumstance.

In the Males of the Genus *Anas*, and *Mergus*, or Duck tribe, the Bronchi form Osseous Cavities, which give particular tones to their voice.

The *Lungs* of Birds differ from those of the Animals of the former class, in several circumstances. They occupy but a small part of what, in Quadrupeds, forms the Thorax; they are firmer in their texture, and not divided into Lobes, though separated above by the Ribs, the interstices of which they occupy. They adhere, at their upper part, to the inner side of the Thorax through their whole length; while below, they have a flattened appearance, where they lie over the Air-Cells.

They adhere to the upper surface of the *Pleura*, in such a manner, that they may be considered as lying on the outside of the Cavity of the Chest. They consist of two red spongy masses, which have less Cellular Substance than in Mammalia, but the Cells are much larger in proportion. The Bronchi do not all end in the Cells of the Lungs; many terminate on their surface, the Pleura being here Cribriform, and allowing air to pass by considerable orifices into Cells, which conduct it through the whole Body.

The *Air Vesicles* are of great size, but vary much in this, as well as in their form, in different Birds, and in different parts of the same Bird. They cóver and inclose all the Viscera of the Thorax and Abdomen, and communicate by wide openings with each other.

Most of the Cells are subdivided, especially in large Birds,

Birds, by incomplete transparent partitions, which allow the air to pass from one part of the Cells to another, and prevent them from being over-distended.

In Adult Birds, the Air-Cells not only communicate with each other by considerable apertures, but also with the Cavities in the middle of the large Bones, of whatever form.

In many, they extend to the Axillæ, and under the Pectoral Muscles, and even along the Shoulders under the Skin of the Wings and lateral parts of the Neck. This is found particularly to be the case in high-flying Birds, in which, also, they are remarkably large.

They are extremely thin, but so dense, as to prevent the air from escaping, except by the apertures which conduct it through the Body.

In large Birds, the Cells are furnished with Fasciculi of *Muscular Fibres*, considered as a Substitute for the Diaphragm. These serve to expel the air received in inspiration, and send it back by the Lungs and Trachea, in which they are assisted by the Muscles on the Thorax, Abdomen, &c.

The distension of these Cells serves to render the Animal lighter in flying, so as to buoy it up in the air, and diminish the necessity of inspiring frequently in a long or rapid flight; and also in singing or swimming; and in large Birds, as the *Ostrich* and *Cassowary*, in running.

They answer, besides, as a kind of secondary Lungs to the Blood, and are useful in the expulsion of the Fæces, Urine, and contents of the Genital Organs.

They are also concerned in respiration, the Lungs possessing

possessing little mobility on account of their attachment above to the Thorax, which has little motion where they are fixed to it. The rest of the Thorax, however, admits of considerable dilatation, so as to determine the air to the Cells; and the double articulation of the Ribs likewise favours this.

Inspiration, in Birds, is owing to a dilatation of the Air-Cells from Muscles acting upon the Thorax; or upon the Lungs, as is observed in such large Birds as the *Ostrich* and *Cassowary*.

Expiration is produced by a relaxation of the Muscles employed in Inspiration; by the action of Muscles situated over the Air-Cells; and more particularly about the Abdomen, bringing the posterior part of the Sternum nearer the Vertebræ; and, according to some Authors, by the power of the Lungs themselves, as is observed in the larger Birds.

The strength of the Voice is in proportion to that of the Aerial Cavities. This facility of modulating it, depends upon the mobility of the Muscles which contract the Lungs. The difference of voice in different Birds depends upon the proportional length, form, consistence, and mobility of the Rings of the Trachea. The cause of the loss of voice in some Birds, as the *Quail*, *Cuckoo*, &c. at certain seasons, is not understood.

OF

OF THE ALIMENTARY CANAL.

THE Viscera of the Abdomen, in Birds, are contained in the same common Cavity with those of the Thorax, and, as in the former class, are covered by the Peritoneum, which is here so confounded with the Pleura, that the two may be considered as one Membrane.

The Animals of this class being divided into *Granivorous* and *Carnivorous*, the Bowels of the two kinds are considerably different from each other.

The upper part of the *Esophagus* agrees in its nature in Birds in general; but in a few, there are peculiarities. In the *Pelican*, there is a remarkable dilatation or Pouch in the Fauces, capable of holding some quarts, and serving as a reservoir of the Food, which commonly consists of Fishes.

There is also, in the Male *Bustard*, a *Throat-Sac* under the Skin of the Neck, which has an opening of considerable size under the Tongue, but the use is unknown.

Granivorous Birds.

The Esophagus is generally a little inclined to the right side of the Trachea, and terminates at the bottom of the Neck in a large Sac, the *Ingluvies* or *Crop*, which is of the same structure with the Esophagus, but thinner.

The

The *Crop*, in the Gallinaceous Birds, is of a globular form, and placed at the fore part of the Chest. The Esophagus terminates at the upper or fore part of this Sac, and proceeds again from its opposite extremity, the Crop forming a sort of *Cul-de-Sac* between these two orifices.

Upon the inner side of the Crop are numerous *Glands*, with very distinct orifices, in large Birds which throw out a liquor to assist in the solution of the Food. In many, the Glands are in irregular rows. In the *Pigeon*, &c. which nourish the young from the Crop, the Glands swell remarkably at that time.

The *Pigeon* has a spherical Bag on each side of the Esophagus, and these, in the *Poulting Pigeon*, are filled with air, so as to give the appearance constantly observed.

The Crop is peculiar to Granivorous Birds, but is wanting in the *Ostrich*.

To the Crop succeeds another Cavity, in the shape of a Funnel, called *Ventriculus Succenturiatus*, *Infundibulum*, or *Second Stomach*. This is situated in the Abdomen, and is commonly smaller than the former. It is more general among Birds than the Crop, and varies much in size in the different Species. It has a covering from the Peritoneum, and is generally thicker than the Esophagus, owing to its numerous Glands, from which a fluid is discharged.

In the *Ostrich*, this Stomach, from its size and form, has the appearance of a Crop. The Mucous Glands here are about the size of Garden-Peas, and have orifices uncommonly distinct. It dilates into a Bag capable

pable of containing several pints of water, and is much larger than the proper Stomach into which it opens.

The Infundibulum, in Birds, ends in the *Ventriculus Callosus*, *Gizzard*, or *Third Stomach*, which, in Gallinaceous Birds, is much larger than the Infundibulum; but in others, it is the reverse. In the *Pie*, the Third Stomach is only about half the size of the Second, and in the *Ostrich*, several times less. It is generally situated in the upper part of the Abdomen, close to the Spine, and resting upon the Intestines; though, in some few Birds, it is covered by these.

It is commonly of a globular figure, and a little compressed, and is composed of four Muscles, remarkable for their great thickness and strength. Two of these are situated laterally, and have Fibres running in a radiated manner about two Tendons placed at the sides of this Organ. The other two Muscles are much smaller than the former, and are situated at the extremities of the Stomach.

The Gizzard is covered externally with a Tendinous Expansion, and lined within by a thick, strong, callous Coat, considered by some as a continuation of the Cuticle. In the *Chick*, it is only a thin Pellicle, and becomes thick from attrition.

This Layer forms irregularities in the inner side, which are adapted to each other on the opposite surfaces. The Cavity of this Stomach is proportionally small, when compared with its external surface, and its two orifices are remarkably near each other.

Its thickness is supposed to compensate for the want of Teeth. So great is the strength of this Organ, that

pieces

pieces of Money, and even Pebbles of the hardest kind, swallowed by a common *Fowl*, have, in a few days, lost considerably of their weight.

Each of the small Muscles at the extremities of the Gizzard, contains a kind of receptacle for the stones necessarily swallowed, while the digested portion of the Food passes to the Intestines.

The *Parroquet*, and some other Birds, are observed to chew the cud like Ruminant Quadrupeds. *Fowls*, *Geese*, &c. having hard and callous Stomachs, are termed *Spurious Ruminating Birds*.

Carnivorous Birds.

The Esophagus here is of great size, for receiving the large substances these Animals swallow, and for discharging by the Mouth, Feathers and other substances, that cannot readily be digested.

In the *Hawk* kind, the Esophagus is so wide, as to be considered by some a kind of Crop; and so large is this passage in some Fish-eaters, that whole Animals are contained in it till the Stomach can receive them.

The structure of the Stomach of these Birds differs much from that of the plurality of Stomachs in the former kinds, being merely a Musculo-membranous Sac. The Food, too, is here more easily digested. But there are many intermediate links in the diversified structure of Stomachs in the Animals of this class.

Most Piscivorous Birds want the Crop; when this is the case, the Infundibulum is larger, as if to supply its place.

The *Pylorus*, in Birds, has no Sphincter. The Intes-

tinal Canal is much shorter than in Mammalia. It varies from twice to five times the length of the Animal. In the *Ostrich*, on the contrary, it is found to be between twenty and thirty times the length. The Canal is also shorter and narrower in Carnivorous Birds than in those living on vegetable Food, yet many Fish-eaters have it equally extensive.

In all Birds, there is a distinction into *small* and *great* Intestines, though, to external appearance, the difference is very inconsiderable. The small Intestines are commonly longer than the great, as in Mammalia; but sometimes shorter, as in the *Ostrich*.

The situation, form, and structure of the Intestines is nearly the same in the greater number of Birds. The *Duodenum* begins near the termination of the Esophagus, but there is a prominence, in some, as the common Fowl, between the two openings, which may prevent the Food from escaping till properly digested. The Gut hangs loose, in the common Fowl, towards the right side of the Abdomen, the rest of the small Intestines making turns, and uniting themselves to each other. The Intestines are destitute of Valvulæ Conniventes in Birds in general; but in many, there is a Villous appearance in them.

There are commonly two *Intestina Cæca* in Birds, a few of the Aquatic kind excepted, which have only one. The Cæca are inserted at the sides of the termination of the Ilium. They are generally smaller at their base, and enlarge towards their shut extremities. They lie parallel to the small Guts, and contain the same kind of Aliment with them. In Granivorous and Omnivorous Birds,

Birds, they are commonly long, and of considerable diameter. In nocturnal Birds of prey, they are in general very large; but in the diurnal Birds of prey, they are wanting, or of inconsiderable size. There are many exceptions to the above rules. In the *Ostrich*, the Cæca are remarkable for their spiral Valves.

From the end of the Ilium, and also from the Cæca, when present, the *Colon* is sent off, which is proportionally short, and differs from that in many of the Individuals of the former class, in not being formed into Cells.

In the *Ostrich*, however, the Colon, as it advances, becomes tacked up into Cells, and gradually increases in diameter, contrary to what happens in other Animals.

The Intestines are fixed to the Body by the *Mesentery*, which arises from the Spine opposite the Anterior Mesenteric Artery. It is of considerable breadth where it is attached to the small Intestine; but what belongs to the Colon is narrow, this Gut being more firmly fixed than the rest.

The *Rectum*, previous to its ending in the Anus, forms a dilatation termed *Cloaca*, which is suspended under the Os Coccygis, and receives the terminations of the Ureters, the ends of the Vasa Deferentia, and Penis, where it exists; the opening of the Oviduct in the Female, and the orifices from the Bag termed *Bursa* FABRICII.

The Cloaca varies in form in different Species, but has more or less of an oval appearance. It serves as a reservoir of Urine and Fæces in both sexes. It is moved by various Muscles which arise from the Bones in the neighbourhood.

The *Bursa* Fabricii is situated at the upper and back part of the Cloaca, into which it opens in both sexes. In some of the large Birds, as the *Goose*, it is fully an inch in length, and is lined with Mucous Glands internally. It is largest in young Birds; in old ones, it is quite contracted. It is constantly found empty, and its use is unknown.

The *Omentum* is wanting in Birds in general, unless a lump of Fat which covers the Intestines in some Aquatic Fowls, be considered as such. In the *Ostrich*, there is an Omentum with a large quantity of Fat.

OF THE ASSISTANT CHYLOPOIETIC VISCERA.

Liver.

The *Liver* is generally larger in proportion, in this class of Animals, than in the former, especially in Birds of prey, and is observed to be larger in *Domesticated* than *Wild* Animals of the same Species. The figure is more uniform in Birds. There are commonly two Lobes of equal size, which occupy both sides of the Abdomen; but in some, the left is larger than the right, or in others, is divided into two Lobules. It is supported by the surrounding Viscera, and is fixed by Processes derived from

from the Peritoneum. The colour is a reddish brown, but the tint varying in different Species.

The *Gall-bladder* is placed between the two Lobes of the Liver, and is sometimes closely attached, at other times is loose and pendulous. It is in some oval; in others, of a spherical figure, and, as in the former class of Animals, has its Fundulus placed undermost.

In many Species of Birds, the Gall-bladder is wanting, as in the *Pigeon*, *Parrot*, and *Ostrich*.

The Hepatic Duct, in Birds in general, opens separately from the Cystic, into the Duodenum. There is no communication between the two Ducts; of course, the Bile found in the Gall-bladder does not get there by regurgitation, as it commonly does in Mammalia, but directly from the Biliary Vessels in the Liver by means of *Hepato-cystic Ducts*, which open either into the Fundus or the Cervix of the Gall-bladder. These, besides supplying it with Bile, assist in connecting it to the Liver.

In some Birds, as the *Duck*, the Hepatic and Cystic Canals unite into a common Tube; and in the *Parroquet*, there are two Hepatic Ducts which open separately into the Duodenum.

SPLEEN.

There is generally one Spleen only, and this varies much in form, being round, oval, reniform, &c. in different Birds. It is situated between the Left Lobe of the Liver and the Stomach, and is fixed in its place by

plies of the Mesentery, as in the former class. As in Mammalia, it is destitute of an Excretory Duct, and as in that class of Animals also, it sends its Blood to the Liver, by which part of the Bile is secreted from it.

Pancreas.

The *Pancreas* of Birds is situated between the Folds of the Duodenum, and is generally of considerable size. It varies a good deal in its form, but is commonly long and straight, and is almost always divided into two parts, and in some of the class there is a double Pancreas. Its Structure is the same as in the former class, viz. a Gland of the Conglomerate kind. It commonly sends one, two, or three Ducts, which are more visible than in other Animals; and these, with few exceptions, terminate distinct from the Biliary Vessels.

Of the Insertion of the Biliary and Pancreatic Ducts there is great variety; but from many comparisons it appears, that the Pancreatic Duct opens first into the Intestine, that the Hepatic is inserted a little farther on, and that at a little distance farther is the termination of the Ductus Cysticus.

Kidneys.

The *Kidneys*, which are proportionally large in this class, are placed in the Cavities of the Ossa Innominata, at the sides of the Lumbar Vertebræ, with a few exceptions. They form a double row of regular Lobes, connected together, though the first are generally separated from

from the rest, and are the largest. On each side, this first Lobe receives an Artery from the Aorta, the others derive them from the Femoral Artery. They return their Blood to the Femoral Vein and Vena Cava.

Each Kidney sends out an Ureter, which terminates in the upper part of the common Cloaca, but not in the Penis.

The Urinary Bladder is absent in the whole class. The Urine generally mixes with the Fæces, and in the common Fowl, has a chalky appearance.

In the *Ostrich* and *Cassowary*, the Cloaca serves as a Bladder, and they are the only Animals of the class which are observed to pass Urine.

RENAL GLAND.

The *Renal Glands* in Birds appear proportionally small. They are situated at the under and fore part of the Kidneys, are generally of an Orange colour, and uniform in their substance.

OF THE MALE ORGANS OF GENERATION.

THE *Testes* and *Vasa Deferentia* are found in all the Male Animals of this class. The Testes are situated in the Abdomen, close to the sides of the Spine, behind

the Lungs, and below the fore part of the Kidneys. They are commonly of an oval, but sometimes of a roundish form, and vary much in size in the different Genera and Species. They increase considerably in bulk in the season of their sexual intercourse, and are proportionally larger than in Mammalia. They are covered, and fixed in the Body, by a Process of the Peritoneum, and consist of a Congeries of delicate Seminal Ducts, which are less distinct than in the former class of Animals.

The *Epididymis* here is closely connected to the Testis, and sends out the *Vas Deferens*, which runs in a flexuous manner near the corresponding Ureter. It becomes larger by degrees, and terminates in the Cloaca, distinct from the Ureter; but frequently, before its termination, it dilates into an oval Sac, that is considered by some authors as supplying the place of a Vesicula Seminalis. The Duct is commonly full of an opaque white fluid, and its outer extremity, in some Birds, as the *Duck*, is situated between two Erector Muscles, which, by compression, can discharge its contents.

The *Prostate Gland*, in this class of Animals, is wanting.

In general, each Vas Deferens terminates in a Penis peculiar to itself, which is a mere Papilla, placed at the side of the common Cloaca, and pointing outwards, as in the *Cock*, *Turkey*, *Pigeon*, and large Birds of prey.

In some, as the *Duck*, *Swan*, &c. the Vasa Deferentia terminate in a single *Penis*, which is of considerable size, and in the relaxed situation, is a simple

simple Tube, coiled up, and concealed in a Pouch opening into the Cloaca. In the erect state, it is some inches in length, but this varies according to the size of the Animal.

Some *Muscles* are placed at its root, for giving it the necessary degree of erection, its own elasticity afterwards relaxing it.

In the *Ostrich*, *Hocko*, and *Cassowary*, the Penis is similar to that in the *Drake*; but, in place of a Tube, there is only a Groove for conducting the Semen from the Cloaca.

No rule is yet found with respect to the Birds that have a double or a single Penis.

In the *Ornithorrynchus Paradoxus*, there are two Penises, as in Birds.

OF THE FEMALE ORGANS OF GENERATION.

THE *Female Organs* consist of the *Ovarium*, or *Racemus Vitellorum*, *Oviduct*, and the *Cloaca*. The Oviduct is divided into *Infundibulum*, *Oviduct* strictly so called, *Uterus*, and *Vagina*. The structure of these parts is so uniform in Birds in general, that the *common Fowl* may suffice as an example.

The Racemus Vitellorum corresponds with the Ovarium in Mammalia, is situated under the Liver, between the anterior portions of the Kidneys, and is inclosed

closed by a Process of the Peritoneum, which attaches it to the Spine. It consists of a cluster of Ova, resembling a bunch of grapes, but varying in size, from the full-grown yoke to that of a grain of mustard-seed. The largest are yellow, the smallest white; and in a *Hen* beginning for the first time to lay, the number is about 500. The Ovaria have Blood-vessels similar to those of Mammalia, which also assist in fixing them in their place.

The largest of the Yolks are always found at the outer side. Each is inclosed in a *Calyx*, or Membrane, and supported on a *Pedicle*, or Foot-stalk, which is fixed to the Ovarium.

When the Yolk is ripe, it bursts the Membrane, and is then received by the Infundibulum, which conveys it to the Oviduct. The Infundibulum has a plaited or folded margin, like the Fimbriæ of the FALLOPIAN Tube, and is connected behind by a round Ligament. The Oviduct is at first straight, but afterwards so convoluted, as frequently to exceed the length of the Bird, and gradually increases in thickness and strength, till it reaches the Cloaca. Externally, it is covered by the Peritoneum, within which are some Muscular Fibres. The inner side is formed by a Membrane covered with Follicles, which secrete the white of the Egg. It has a number of broad longitudinal folds, and is connected to the Spine by a kind of Mesentery.

The Oviduct terminates, and deposites the Egg, in the Uterus, which is full of wrinkles internally, and may be considered as merely a dilated part of the Oviduct.

duct. In the Uterus, the Egg receives first its form, and then its shell.

The *Vagina*, in the common Fowl, is about an inch and a half in length. From this the Egg is discharged into the *Cloaca*, by the Muscular power of the Uterus, and action of the surrounding parts. The termination of the Vagina is at the left side of the Cloaca, which receives also the end of the Rectum and the two Ureters.

Behind, and above the Cloaca, is the *Bursa* FABRICII, so called by the Author, who was of opinion, that the Organ receives and retains the Semen of the *Cock*; it exists, however, also in the *Hen*.

Behind the Ossa Pubis, is the external opening of the Cloaca, that is larger in the *Hen* than in the *Cock*. The Anterior Labium, which is the smaller of the two, is covered by the posterior one, termed *Velabrum*.

Structure of the Egg.—The Shell is lined by a white and very dense substance, the *Membrana Albuminis*, that is destitute of Blood-vessels. The two Laminæ of which this Membrane is composed, are separated at the large end, and leave between them a cavity filled with Atmospheric Air, the *Folliculus Aeris*, which is larger in an Egg kept for some time than in one recently laid.

The Membrana Albuminis incloses the *Glaire* of the Egg, which is separated into an outer and inner portion; the inner, as well as the outer, is surrounded by a Membrane, delicate and very dense, and yet allowing the Glaire to transpire when the Egg is long kept, especially

in

in a warm atmosphere. The outer Glaire, which is more fluid and transparent than the inner, can be readily separated from it after being boiled, or otherwise hardened into a coagulum.

The inner Glaire incloses the *Yolk*, which is contained in a Membrane termed *Yolk-bag*. The Yolk is proportionally heavier than the Glaire, and has attached to the Membrane which covers it, two white Bodies like coagulated Glaire, termed *Chalazæ* or *Grandines*. The other extremities of these Bodies, considerably expanded, penetrate and float in the Albumen.

The Chalazæ form two ends of an axis, being placed at the opposite sides of the Yolk, but at a little distance from its centre, in consequence of which the large portion preponderates.

On the surface of the Yolk-bag is the *Cicatricula* or *Macula*, termed also the *Tread* of the *Cock*, which is surrounded by concentric circles, the *Halones* or *Circuli*, the use of which, and of the Chalazæ, is not yet fully ascertained. The Cicatricula, being placed upon the smaller portion of the sphere of the Yolk, is found uppermost in whatever position the Egg happens to be placed.

Changes produced upon the Egg in time of Hatching.—This process is effected by the assistance of Atmospheric Air, and a certain degree of heat, both of which circumstances are produced by Incubation, or by the Egg being kept for a sufficient length of time, in air heated to an equal degree with that produced by the Animal. But varnishing an Egg all over stops the progress of Incubation, by obstructing the access of the air, though

though covering the large end with a varnish has not that effect.

The influence of the Male Semen is supposed to affect the Ovum either in the Uterus, or to pass through the Tube, and fecundate the Ova in the Yolk-bag, but in what manner is not yet understood.

During Incubation, the Folliculus Aeris is gradually expanded, air being now secreted from surrounding Vessels, which prevents the *Chick* from being too much moved about in the Shell. The Albumen becomes thinner and more turbid, part of it escapes through the Shell by evaporation, the rest of it is by degrees consumed by the Chick, till at last there remains but a white Cretaceous Substance at the small end of the Shell.

The white of a fecundated Egg is somewhat coagulable, and perfectly fresh, during the whole period of hatching. The Yolk becomes paler and more fluid for some time, on account of being mixed with the white. Its Membranes become firmer and stronger. By degrees it becomes depressed in the middle, and forms an Arch about the Chick. It remains quite free from corruption, is coagulable all the time of Incubation, and, during this period, is entirely taken into the Abdomen.

The Chalazæ degenerate into a chalky-like substance towards the end of Incubation. The Cicatricula, by enlarging, forms the *Amnios*, which contains the *Colliquamentum*, or liquor in which the Chick is immersed at the earlier part of Incubation, but which is consumed by the end of it.

By degrees, Umbilical Vessels are formed upon the Amnios,

Amnios, Yolk, and Membranes of the Albumen, in which last substance the greater part of the Branches are expanded. The lining of the Shell is now covered with Blood-vessels, expanded upon a Membrane which forms the Chorion. Near the end of Incubation, the Umbilical Vessels begin to shrivel, and, at the exclusion of the Chick, are quite diminutive.

Production of the Chick.—At the end of the first day, a small white spot, the *Nidus Pulli*, seu *Colliquamentum*, is discerned near the Cicatricula. On the second day, the Chick is observed in the form of a Gelatinous Filament, and the Cicatricula soon afterwards vanishes. At the end of the second day, Blood-vessels appear upon the surface of the Yolk, and these soon become connected to the Chick. The Vascular part is termed *Figura Venosa*, or *Area Vasculosa*. The Arteries arise from the Mesenteric; the principal Vein goes to the Porta. Besides the Blood-vessels, a Canal is formed in the course of Incubation, which joins the Membrane of the Yolk to the Intestinum Ilium of the Chick, under the name of *Ductus Vitello-intestinalis*. Third day, the *Punctum Saliens*, or *Heart*, appears, and is distinguished by its motion. The Spine is seen in a curved state, with prominences, which are the Brain and Eyes, the latter of which are remarkable for their great proportional size. Fourth day, the Abdominal Viscera appear, after which the Extremities sprout out. A Vascular Membrane, the *Chorion*, or *Membrana Umbilicalis*, begins to form about the Navel, which, increasing by degrees, lines almost the whole inner surface of the Membrana Albuminis during the latter half of the period of Incubation.

tion. The Chorion consists of innumerable Arteries and Veins; the latter are distinguished from the former by being filled with pure red Blood, while the Arteries have a livid appearance, on account of transmitting carbonated Blood from the Animal. The Chorion is therefore considered as supplying the office of Respiratory Organs, while the Chick lies in the Amnios, and is prevented from breathing. Fifth day, the Lungs are perceived. Sixth, there is voluntary motion. Ninth, Ossification commences; traces of yellow Vessels on the Yolk-bag, *Vasa Vitelli Lutea*, begin to appear. These afterwards expand in the substance of the Yolk, and, by degrees, carry it into the Veins of the Yolk-bag for the nourishment of the Chick. Fourteenth, the Feathers are discerned. Nineteenth, the Animal has the power of using its Vocal Organs, and, some time before its exclusion, may frequently be heard making the same kind of sound that Chickens make after they are hatched; and this in consequence of breaking with the Beak, the Air-bag placed at the great end of the Shell. Twenty-first, it makes its appearance, sometimes by bursting the Shell irregularly, at other times perforating the larger end with its Beak.

While the Chick lies in the Shell, it is coiled up, with its Neck bent forwards, the Head covered by the Wing, and the Yolk between its Legs. Directly after leaving the Shell, the remains of the Yolk and its Bag are observed in the Abdomen; the former is taken into the Intestines, and serves for nourishment till the Animal acquires strength enough for another kind of Food.

PART III.

OF REPTILES.

OF THE BONES.

The general structure of the Skeleton of Reptiles varies much in the different orders of the class. The *Cranium*, for the most part, is large in proportion to the size of the Brain, though small when compared with the bulk of the Head.

In the *Turtle*, the apparent magnitude of the Head is owing to the Accessory Bones, between which and the Cranium there is a large space occupied by Muscles and Glands, and by the Organs of Vision. The Cranium is joined to the Vertebræ of the Neck by a single Occipital Condyle.

The *Lower Jaw* is composed of five pieces, one in the middle, and two at each side; and is articulated somewhat after the manner of the articulation in Birds. It has no *Condyle*, but a hollow articular surface, which is joined to an eminence of the Temporal Bone; a structure the reverse of that in Mammalia.

In all other Reptiles, there is nearly the same kind of articulation as in the *Turtle*. There are no *Teeth* in the *Turtle* kind, in place of which their Jaws are covered

vered with a Horny substance, similar in structure and connexion to the Hoof on the Foot of the *Horse;* and so strong, as to be capable of breaking substances of great hardness.

The *Os Hyoides* varies much in this and the other orders of the class, though in general it approaches, in its appearance, to that of Birds.

Seven *Vertebræ* enter into the composition of the Neck. The Trunk is formed of two great portions, the *Dorsal* and *Abdominal Shells.* The Dorsal, Lumbar, and Sacral Vertebræ, are all united into one piece, but the Vertebræ of the Tail are free and moveable.

The Dorsal Shell consists of a great number of Osseous Plates, regular in their position, and approaching to a quadrangular form. They are connected to each other by Suture, and joined to the Abdominal Shell by a thick and very tough Skin.

The Abdominal Shell, like the Dorsal, is also composed of many plates joined together by Suture, and forming a kind of Sternum, which covers almost the whole inferior part of the Body of the Animal.

The Os Innominatum possesses the same number of pieces with that in Mammalia; but the Os Pubis is the largest, and the Os Ilium the smallest of the three.

The Ribs are eight in number, but are all anchylosed with the Vertebræ of the Back and the Dorsal Shell. They terminate in a border which surrounds the Shell, and are united to it by Suture.

The *Scapula* has a singular situation before the Shell of the Abdomen. The *Clavicle* consists of two pieces joined in an acute angle. There is also a *Fork-like Bone* in these Animals, to which, and to the Clavicle

and Scapula, the Os Humeri is fixed as in Birds. This and the other four-footed Reptiles have two Bones in the *Fore-Arm*, though the division into two is not very distinct.

In the *Tortoise*, the Feet are proportionally small, in consequence of which the Animal is observed to be slow in its motions.

There are three Ranges of Bones in the *Carpus*, the pieces varying in number in the different ranges. The Phalanges of the Fingers or Toes are nearly as in Mammalia; but in the *Sea Tortoise*, the different pieces are flat, being formed into a kind of Fins.

The *Frog* and *Toad* have no motion in the *Upper Jaw*, and they are destitute of real *Teeth*, though they have pointed Bodies serving as a substitute, and placed in the Palate; the *Frog* has them also in the Upper Jaw. The Head is joined by two Condyles to the Spine, which is short, and terminates behind by a single Bone, articulated with the Os Innominatum.

The *Dorsal Vertebræ* have broad Transverse Processes, that may somewhat supply the place of Ribs, which are wanting here. The *Os Sacrum* consists of one long Bone. There is no Os Coccygis in these animals.

The *Scapula* is joined to the Sternum by double *Clavicles*, or there is a Clavicle and Fork-like Bone in each side. The *Fore-Arm* and *Leg* consist of a single Bone, divided at its extremities into two portions. The Carpus is formed of three ranges. The *Frog* has one Bone to the First Digit, two to the second and third Digits, and three to the fourth and fifth.

In the *Lizard* tribe, the Cranium, or at least the cavity for the Brain, is uncommonly small. In a *Crocodile*

dile that measures between twice and thrice the length of the Human Body, the cavity of the Cranium is only about three inches long, and the third part of that in breadth; and in the *Cameleon*, it is not found larger than a common pea.

The *Crocodile* has a single Parietal Bone, but both in that Animal and the *Lizard*, numerous pieces enter into the composition of the Lower Jaw, which is proportionally larger in the former Animal than in any other creature. The two Intermaxillary Bones form the end of the Maxilla Superior, and surround the Nostrils. The Under Jaw corresponds with that of other Animals of the class, in having an Articular Cavity for receiving a Condyle of the Temporal Bone.

An uncommon structure is observed in the *Teeth*, which consist of two Sets, one contained within the other, which is found to facilitate their change.

The Head is joined to the Atlas by a single Condyle.

Lizards have perfect Ribs, of which there are twelve pairs in the *Crocodile*, but the Sternum is in a great measure Cartilaginous. This Animal is remarkable in having a double Sternum, one belonging to the Thorax, and another extending along the Abdomen as far as the Pubes. There are Seven Cervical Vertebræ here, but the five last are found to be so encased, that the Animal cannot turn the Neck laterally. The Sacral Vertebræ are all joined into one piece in all the Animals of this order. The Bones of the Extremities have nothing very remarkable.

In the *Salamander*, the Sternum, Clavicle, and Scapula, are in one piece, which receives the Head of the Os Humeri. In this class, the Fibula, as well as the

Tibia, is in general articulated directly with the Os Femoris; and in all, the Astragalus is joined to the Tibia, and the Os Calcis to the Fibula.

Of the *Serpents*, one set move the under Jaw only, another set, viz. the *Vipers* and *Venomous Serpents*, move both Jaws. The Lower Jaw is articulated by a Glenoid Cavity, which corresponds with a Condyle of the Temporal Bone at the bottom of the Cranium.

Serpents, whether *innoxious* or *poisonous*, are divided according to the nature of their Teeth. The former have both Jaws beset with small Teeth in two rows, with an interval between them. In the Poisonous Species, the outer row in the upper Jaw is wanting, but their place is supplied by long hollow *Tusks*, which are connected with the Bag containing the poison, and serving as Excretory Ducts to convey it from the Glands at their roots, into the wound the Animal inflicts. The Tusks lie concealed in the Jaw, but can be darted out at the will of the Animal. In all the poisonous *Serpents*, the Upper Jaw is moveable on the Cranium. This allows them to open the mouth widely, by which they are enabled occasionally to swallow an Animal entire, the diameter of which sometimes surpasses that of their own Body.

Serpents are remarkable for the number of their *Vertebræ*, which form almost the whole Skeleton. They vary in number from about 30 to upwards of 250, and are nearly of the same form from the Head to the Tail. They are connected by Ball and Socket. This articulation, however, is of such a nature as to allow free motion laterally, but little in a vertical direction.

The

The last Vertebra of the Tail in the Rattle-snake supports the *Rattle*. The Sternum is wanting, and, there being no Limbs, the Bones of the Extremities of course are absent.

OF THE MUSCLES.

THE two principal divisions of the Animals of this class, viz. those with, and those without Feet, have a remarkable difference in the form and number of their Muscles. In the former, viz. the *Turtle*, *Frog*, &c where the Trunk of the Body possesses proportionally a small degree of mobility, a number of Muscles are wanting, though the others are strong. In the Animals of this class without Feet, namely, the *Serpents*, the Muscles are slender, but extremely numerous, on account of the number of the Vertebræ, and the want of Anterior and Posterior Extremities.

In the *Turtle*, the Spine possesses no motion but in the parts belonging to the Neck and Tail. The Back and Loins, being ossified together, have no Muscles.

The Diaphragm, and also the Muscles of the Abdomen, are wanting; but the other Muscles are remarkably strong. The Neck possesses chiefly Muscles for elongation and retraction; the Neck being bent, when retracted into the Shell, somewhat like a Z, though it can be moved in various directions when it protrudes from the Shell. The Muscles for these motions are nu-

merous. Some pass from the under and fore part of the Back Shell to the Vertebræ of the Neck, and others from one set of Vertebræ to another. One Muscle is peculiar to this Animal, which arises from the first Dorsal Vertebra, and is fixed to the sixth and seventh Cervical Vertebræ. It begins the extension of the Neck, when the Head is concealed in the Shell.

About half a dozen pairs of Muscles lie on the back part of the Neck, chiefly for raising the Head, or pulling it laterally. A few Muscles also appear below, particularly one supplying the place of the Sterno-mastoideus, for bending the Head, and producing a slight elevation of the Shoulder.

The Muscles of the Shoulder are only three in number, and are analogous to the Trapezius, Levator Scapulæ, and Subclavius. The Muscles of the Humerus are more numerous than in other Animals, to give the necessary motions in swimming. They arise from the Bones of the Shoulder, and from the inner side of the Dorsal and Abdominal Shells. The Pectoralis Major is composed of several portions. There are something like two Deltoids. The other Muscles are analogous to the Latissimus Dorsi, Levator Brachii, Teres Major, and Biceps.

The Muscles of the Fore-arm, and remaining part of the Anterior Extremity, are in a great measure Aponeurotic, the Member being in the form of a Fin, as in the *Cetacea*. This is particularly the case in the *Sea Tortoise*, where the Muscles are Aponeurotic Bands, which strengthen the Articulations.

Muscles of the Posterior Extremity.—There is a Muscle,

Muscle, analogous to the Quadratus Lumborum, lying under the Dorsal Shell, and moving the Os Ilium; and another, supplying the place of a Rectus Abdominis, arising from the posterior extremity of the Abdominal Shell, and fixed to the Pubes. Of the Muscles of the Thigh, there are different Adductors. A Muscle from the Pubes is fixed to the small Trochanter, and holds the place of the Iliacus and Psoas. One Muscle arises from the Spine, and two from the Pubes, which correspond to the Glutei. A Muscle analogous to the Obturator Internus arises from the Ilium, and is fixed to the great Trochanter. The Muscles of the Leg are analogous to the Semi-membranosus, Semi-tendinosus, and Sartorius. There is an Extensor, a Rectus, and two Bicipites. One remarkably thin Muscle arises from the Coccyx, and passes under the Skin of the Extremity to its insertion, nearly opposite the Heel. It bends the Leg, and extends the Foot. In the *Sea Tortoise*, the Muscles of the Foot, and also of the Toes, are chiefly Aponeurotic.

In the *Frog*, few Muscles belong to the Spine. A Muscle analogous to the Coccygeus draws the Coccyx into the same direction with the Spine. There is a sort of Sacro-lumbalis, which is fixed to the Transverse Processes of the Vertebræ, and extends as far as the Head; an Obliquus Superior, a Rectus Anterior, and Intertransversales.

The Abdominal Muscles, on account of the want of Ribs, are inserted into the Sternum. There are few Muscles belonging to the Head; most of those inserted

into it are likewise employed in moving the Superior Extremities.

Anterior Extremity.—Of the Muscles of the Shoulder, the Serratus Magnus arises from the Head and Transverse Processes, and goes to the Scapula. The Pectoralis Minor is wanting. The Levator Scapulæ arises from the Occiput. The Omo-hyoideus is present, but the Trapezius is wanting. There is a Rhomboideus, but no Subclavius. The Muscle analogous to the Sterno-mastoideus goes from the Scapula to the Head. The Muscles of the Arm consist of a Pectoralis Major, and an assistant to it; a Latissimus Dorsi, a Subscapularis, supplying also the place of the Coraco-brachialis, and a Deltoid. The Supra and Infra Spinatus, with the Teres Major and Minor, are absent.—Of the Muscles of the Fore-arm. A Sterno-radialis supplies the place of the Biceps. There is no Brachialis Internus, but a large Triceps, a Supinator, and a Pronator. The Muscles of the Hand are similar to those in Mammalia. The Thumb has an Extensor, but wants all the other Muscles.

Posterior Extremities.—The Psoas Parvus is wanting, but there is a Quadratus Lumborum which moves the Os Ilium. There is only one Gluteus, which supplies the place of the Medius. The Pyriformis, the Gemini, and Obturator Internus, are wanting; a long Quadratus Femoris, no Psoas Magnus; an Iliacus Internus, Pectinalis, three Adductors, an Obturator Externus, though no Foramen Thyroideum.

Of the Muscles of the Leg, the Muscle supplying the place of the Vasti and Cruralis has only two heads. The Rectus

Rectus is wanting. The Biceps has only one belly, and is fixed to the Tibia, there being no Fibula. There is a Semi-membranosus, Semi-tendinosus, Gracilis, but no distinct Popliteus.—Muscles of the Foot and Toes. The Gastrocnemius has only one belly; there is no Soleus nor Plantaris. The Tibialis comes off from the Os Femoris, and has an assistant which arises from the Tibia, and goes to the long Bone of the Tarsus. There is a Tibialis Posticus, but only one Peroneus. The Extensor Longus Digitorum, and Flexor Proprius Pollicis, are wanting. There is a distinct Extensor Brevis Digitorum, Superior and Inferior, Interossei, and a Flexor Digitorum Communis.

OF THE INTEGUMENTS.

THE *Integuments* of Reptiles consist of simple Skin, Scales, Rings, or Shields, and all of these covered with Cuticle. The greater number are covered with Scales. The surface of the Body differs from that in the former classes, in having neither Hairs nor Feathers. In the *Turtle*, the *Epidermis* is only distinct upon the Neck and Limbs; in other parts of the Body, it is incorporated with the Shell. In the *Frog* and *Salamander*, the Cuticle is a Mucous Membrane, which separates in tatters at different seasons of the year.

Lizards,

Lizards, both of the water and land kind, frequently change their Skin, which is pulled off chiefly by the assistance of the Feet. In *Snakes*, it comes off at moulting seasons, forming what is called the *Snake's Shirt*. In the *Tortoise*, the Shell never changes.

The *Scales* vary according to the kind. In the *Tortoise*, they are of a Horny nature, differing in hardness and figure. In the *Crocodile*, they are Osseous. In a great part of *Lizards* and *Serpents*, they are small plates of Skin, with the Cuticle between them. In *Reptiles* with Scales, as the *Lizards*, the Skin is dry. In those with naked Skins, as the *Frog* and *Salamander*, it is moist, being covered with a viscid fluid.

In *Serpents*, there is a strong *Skin* under the Scales, intimately connected with the Muscles.

The *Cellular Substance*, more or less loose in Reptiles, connects the Skin to the parts underneath.

In the *Frog* and *Toad*, the Integuments are remarkable in adhering to the Body at certain points only, and there, chiefly by Vessels and Nerves, viz. about the Mouth, Linea Mediana of the Body, Arm-pits, and Groins. In other parts, the Animal lies loose in the Skin, as in a Bag.

Between the Epidermis and Skin, and under the Scales, the *Corpus Mucosum* is situated, which varies in colour, having all the different tints in the different individuals of the class.

In the *Camelcon*, some *Frogs*, &c. the colour changes occasionally, in consequence of light, heat, effects of passion, &c. In a *Toad* kept constantly in the light, the colour changes to a pale green; while the same kind

of

of Animal, lurking in the earth, acquires the colour of the substance which surrounds it.

Reptiles have likewise their *Papillæ Nervosæ*, but these are found chiefly in the Feet.

The *Glands* of the Skin are more visible in this than in some of the preceding classes. In the *Lizard*, there is a range of Follicles under each Buttock, which discharge a viscid humour. In the *Toad*, Glands are irregularly dispersed over the Skin; and in the *Salamander*, along the Back, which throw out an acrid matter, especially when the Animals are irritated; yet these Reptiles are often handled with impunity.

The *Panniculus Carnosus* exists in the Neck of the *Turtle*, and some appearance of it is observed in the Neck of the *Frog*; but in the Body of the Animal, it is wanting.

The *Claws* on the Digits of the individuals of this class, are wanting wherever the Animal does not use its feet for seizing its prey, or for walking, as in the *Tortoise*, *Frog*, &c.

OF THE BRAIN.

THE *Brain* of Reptiles, consisting, as in the former classes of Animals, of Cerebrum and Cerebellum, is extremely small in proportion to the size of the Cranium.

nium. In some, it is several thousand times less than the Body, and without being divided into Circumvolutions.

It is covered by the same *Membranes* as in Mammalia and Birds, but the Dura Mater has no Processes.

The *Cerebrum* consists of four roundish eminences, viz. two Hemispheres, and two Thalami Optici, which are remarkable in their situation, being placed behind the Hemispheres. It has Lateral Ventricles, with Corpora Striata, and a Ventricle besides, in each of the Thalami, which communicates with the third. This last has an Anterior and Posterior Commissure, but the Nates and Testes are wanting.

The *Cerebellum* lies behind the Cerebrum, and has no Arbor Vitæ. A fourth Ventricle exists in the *Turtle*, and probably also among the other orders of the class.

The *Spinal Marrow*, in most of the Species, is of great size when compared with the Brain.

The *Olfactory Nerves* arise from the Anterior Extremities of the Hemispheres, and go to the Nose, after the same manner as in Birds. The Canals receiving them have a common opening from the Cranium. The *Optic Nerves* are less or more connected, as in the two former classes; but there is scarcely any union of their Medullary Substance.

The *Third Pair* also agree in general with those in Birds and Mammalia. The *Fourth* are nearly similar in all red-blooded Animals. The *Fifth*, as in the former Animals, are also divided into three Branches. The *Sixth* agree with those of Mammalia and Birds. Of the *Seventh Pair*, the Portio Dura is small, there being

being little soft substance in the parts of several of those Animals on which this Nerve is dispersed. The Portio Mollis is smaller or larger in proportion to the extent of the Organ of Hearing. The *Eighth* and *Ninth* have nothing remarkable. The Great Sympathetics have evident Ganglia, like those of Birds, and are also connected with the neighbouring Nerves. They form a Cardiac Plexus, a Ramus Splanchnicus, and are at last lost upon the origin of the Tail.

The Cervical Nerves, in the *Tortoise*, are distributed nearly as in Mammalia. The three last pairs enter into the composition of the Brachial Plexus.

In other Reptiles, the Nerves vary in number and distribution, according to the number of the Cervical Vertebræ, and the presence or absence of the Ribs.

Of the *Brachial Plexus*, the three last Cervicals, and first Dorsal, go to the Anterior Extremity. In *Frogs*, instead of a Plexus, a single large Nerve goes to the Anterior Extremity. In *Serpents*, the Brachial Plexus is wanting, there being no external Members. There is no proper Diaphragmatic Nerve in any of the class.

The *Dorsal* and *Lumbar* Nerves agree in number with that of the Vertebræ.

The *Sacral* and *Caudal* Nerves are not very distinct. They lose themselves in the Bones, Muscles, and Skin of the posterior parts of the Body.

The Posterior Extremity has the same distinction of Obturator, Anterior Crural, and Sciatic Nerves, as in Mammalia; but they vary a little in their origins and distributions, according to the shape of the Member. In the *Frog*, these Nerves are readily traced.

OF

OF THE EYE.

THE *Eye* of Reptiles has been little attended to. There is some variety in the Eye-lids of the different orders. The *Tortoise*, *Crocodile*, and *Frog* kind, have three, as in Birds. The third is proportionally the largest.

Some Reptiles with Feet, and the *Serpents*, have no Eye-lids, the common Integuments forming a kind of window, behind which the Eye moves freely.

The *Lacrymal Gland* is as variable here as the Eye-lids. In the *Sea Turtle*, it is large and lobulated. The fresh water *Turtle*, the *Frog*, and *Toad*, have Glands of diminutive size. In *Serpents*, the Lacrymal Gland is wanting.

In the *Turtle* and many *Lizards*, there is an *Osseous Ring* on the fore part of the Eye, composed of different plates, as in Birds.

The *Iris*, in Reptiles, generally presents a beautiful gilding.

The *Ciliary Processes* vary in length in different Reptiles. In the *Turtle*, they are observed with difficulty, but they leave a distinct impression upon the Vitreous Humour. In the *Crocodile*, they are prominent, and have a Plexus of Blood-vessels, which are very distinctly seen.

The *Lens* is nearly of the same form as in Birds.

The *Optic Nerve* passes through the bottom of the Eye

Eye by a round hole, and, after entering the Ball, forms a Tubercle, from the edges of which the Retina is sent off.

In the *Tortoise* and *Crocodile*, six *Muscles* surround the Optic Nerve, and serve for the different motions of the Eye. In the *Frog* and *Toad*, there are only three, united into a Funnel which embraces the Nerve.

OF THE EAR.

THE *Organ of Hearing* varies more in this than in any other class of Animals. There is no *External Ear* nor *Meatus Externus* in Reptiles. The *Crocodile* is the only instance given of a sort of External Ear, and two fleshy Lips for an External Meatus.

The *Membrana Tympani* is present in some of the class, and wanting in others. In the *Turtle* and *Frog*, it is upon a level with the surface of the Body, and is covered by the Integuments. In the former, it is composed of a Cartilaginous Plate, and in the latter, as well as in the *Toad*, it is distinguished by differing in colour from the rest of the Skin.

In the *Lizard*, the Skin over the Tympanum is known from its transparency, like the Cornea; but in many, as the *Chameleon*, the Membrana Tympani is wanting, or cannot be distinguished from the rest of

the Skin. It is wanting, also, in the generality of *Serpents.*

A *Tympanum*, *Eustachian Tube*, and *Semicircular Canals*, are present in the *Turtle*, *Frog*, and in most *Lizards.* In the *Turtle*, the Tympanum is in some measure divided into two parts by a contraction, which is more distinct in the *Crocodile*, where the inner apartment has Cells, somewhat like those in the Mastoid Process in the Human Species, but larger. In *Lizards*, the *Frog*, *Toad*, &c. the Tympanum is Membranous behind, and has a short but large Eustachian Tube, which communicates with the Mouth.

There is neither Tympanum nor Eustachian Tube in *Serpents*, and a few others; but a rudiment of a Cartilaginous Ossiculum exists in some, which is inclosed in Muscular matter, the inner extremity occupying the Fenestra Ovalis. In the *Turtle* and *Lizards*, as in Birds, there is a simple *Ossiculum Auditus*, with a small Cartilaginous Stalk, which is joined to the Membrana Tympani. The *Frog* and *Toad* have two Cartilaginous Ossicula, one joined to the Membrana Tympani, the other articulated with it, and with the Fenestra Ovalis. In *Serpents*, there is a rudiment of an Ossiculum, the outer end of which touches the Skin, the inner the Fenestra Ovalis.

Of the *Muscles* of the Ossicula, little is known in Reptiles.

The *Semicircular Canals*, in many of the individuals of this class, approach to a circle; each has an *Ampulla*, and there is a *Sac* in place of a *Vestible*; but the *Fenestra Rotunda*, and a complete *Cochlea*, are wanting, though

though there is the vestige of the latter in some of the class. In the *Tortoise* and *Lizards*, the Sac contains a quantity of chalky matter, which, in the *Crocodile* and some other *Lizards*, is formed into three small, soft, stony concretions; and there is a kind of Cochlea formed by a prolongation of the Sac. It is of a conical form, is slightly curved, has a Cartilaginous partition dividing it into a double Canal, and is something similar to that in Birds. There is a vestige of it also in *Serpents*. In the *Frog*, *Toad*, and *Salamander*, the Sac contains also a Cretaceous Matter.

The Membranous Labyrinth has many Blood-vessels, which are very visible in some of the large Reptiles. It has also Nerves which are analogous to the Portio Mollis in Man, and these are plentifully dispersed upon the Sac and the Ampullæ.

OF THE NOSE.

THE *Organ of Smell* is less extensive in Reptiles than in the former classes. Some have two or three Cartilaginous Eminences, covered by the Schneiderian Membrane; others merely a thickening of that Membrane. These eminences are somewhat analogous to the Conchæ of warm-blooded Animals, and divide the Cavity of the Nose into so many Fossulæ; but they have no Osseous Laminæ.

The Nostrils have some Muscular Fibres, which give them a small degree of contraction and dilatation. The Internal, or Posterior Nares, are placed farther forwards than in other Animals. In the *Crocodile*, on the contrary, they are far back. There is no Velum Palati. The Foramen Incisivum is considerable in some, as the *Turtle*, *Frog*, *Crocodile*, and *Salamander*; but in others, it is not perceivable.

The Nerves here are much the same as in Birds. In the *Turtle*, the Olfactory is a strong, though slender Nerve; the Ramifications are easily traced in the Cavity of the Nose.

OF THE MOUTH.

TONGUE.—The Tongue here varies in the shape, size, and general appearance. In some, it is very extensible; in one or two rare instances, it is so much fixed down, that its existence in such has been denied. Of the *Papillæ*, there is only one kind, there being nothing like Glands placed in Calices.

In some of the class, as the *Turtle*, many *Lizards*, &c. it is closely covered, at its anterior margin, with long, soft, conical Papillæ, which give the appearance of Velvet. In a great part of the *Lizard* tribe, the Tongue is capable of being considerably elongated, in consequence

consequence of the action of Muscles connected to the Os Hyoides, &c.

In the *Frog* and *Toad*, the Tongue is large, fleshy, smooth, and covered with Mucus. In the state of rest, it is doubled upwards and backwards in the Mouth. In seizing the prey, it is thrust so far out of the Mouth, as to lay hold of Insects or other Food, by doubling itself down.

In the *Crocodile*, the Tongue is quite fleshy, and has very short Papillæ, but is so fixed down, as to be scarcely observable. In the *Salamander*, it is fixed as far as its point, motion being only allowed in the lateral parts. In the common *Lizard*, the Tongue is remarkable for its extensibility. It is forked at its extremity, and terminates by two long semi-cartilaginous, but flexible points.

The Tongue of the *Chamelcon* is wrinkled transversely; is club-shaped and hollowed above. It is concealed in a sheath, and covered with a glutinous fluid, and is thrust five or six inches from the Mouth in catching Flies, &c.

In *Serpents*, the Tongue is round and slender, remarkably smooth, has a horny appearance, and is forked at its anterior extremity. In most of the Species, the root is inclosed in a Membranous Sheath, and the tongue can be thrust out to a considerable extent.

Salivary Gland.—In some Reptiles, as the *Turtle* and many *Lizards*, though not in the *Lizards* of this country, the Tongue is composed, in a great measure, of a thick Glandular mass, covered with innumerable

Tubes united at their basis, and discharging a secreted liquor from their other extremities.

The *Amphibia* of CUVIER, viz. the *Seal* and *Walrus*, have the same apparatus, but not in the same situation, being directly under the Tongue.

Besides these Glands, some *Serpents*, viz. all with Tusks or Fangs in their Upper Jaw, have others which correspond with the Salivary Glands of Mammalia. They are placed behind each Orbit, and have two Muscles, which, by raising the Tusks, compress the Glands, and push the venom through Canals in the Fangs, which terminate by an oblique opening at their point, and serve as Excretory Tubes to the Glands.

OF THE HEART AND BLOOD-VESSELS.

THE general structure of the Heart is the same among the different Animals of the class, but there is some variety among the different orders. The *Turtle* tribe, the *Lizards*, and many of the *Serpents*, have two Auricles, and an appearance of two Ventricles. In the *Frog* kind, there is but one Auricle and one Ventricle. In many Reptiles, the Auricles are proportionally much larger than in the two preceding classes. The Columnæ Carneæ are less raised. The Right Auricle receives the Blood from the Body, the Left from the Lungs.

The

The Ventricles have Cavities small in proportion to their external appearance, owing to the great thickness of their walls. Internally they have, in the three first orders or tribes, numerous Columnæ Carneæ.

In the *Turtle* kind, there is a strong Pericardium, united to the Peritoneum, in the manner the Diaphragm is united to the Pericardium in the Human Body. The two Auricles are separated by a complete partition. The two Cavæ terminate in the Right Auricle, where there are two Valves, and the Pulmonary Veins in the Left, where there are also a pair of Valves. Each Auricle communicates with a corresponding Ventricle. The two Ventricles communicate by a large opening. In the Right Ventricle, there is a hollow Muscular Valve, which prevents the return of the Blood to the Left.

The Arteries arise from the Right Ventricle only. They come off in three large Trunks, or there are three Aortæ, two of which go to the Abdomen. The Right is the proper Abdominal Aorta; the Left, the *Ductus Communicativus* of MERY; and Third, the Pulmonary Artery.

In consequence of this structure, the Aortic Circulation can proceed without interruption while the Animal is under water, which is different from what happens in the two former classes.

In the *Lizard* tribe, the Pericardium adheres, as in the *Tortoise*, to the Peritoneum, which covers the convexity of the Liver. The Auricles are in general similar to those of the *Tortoise*, but the Ventricle is observed to vary much in certain Genera and Species of this

order. In others, particularly in the *Crocodile*, it is more complex, being formed into three apartments, which have numerous orifices in their partitions, and these receive the Blood from the Right and Left Auricles, as in the *Tortoise*, where also Valves are placed to prevent its return. From the different apartments the three great Arteries go out, viz. the Right and Left Aorta, and Pulmonary Artery.

In the *Serpents*, the Heart is more simple than in the *Crocodile*; there are two Auricles and a Ventricle, with two apartments, and a large communication, or the Heart here resembles, in structure, that of the *Tortoise*; there are, within the Ventricle, also two Auricular Valves, and many Columnæ Carneæ; the former preventing the return of the Blood to the Auricle, the latter mixing the Blood from the Lungs, and that from the rest of the Body, intimately together.

In the *Frog* and *Salamander Aquatica*, the Heart has only one Auricle and one Ventricle, with some Columnæ Carneæ, but these not detached from the sides of the Ventricle. The Ventricle opens into the common Trunk of the Artery by a single orifice.

PRINCIPAL BLOOD-VESSELS.

Tortoise.—From the Right Ventricle two or three large Arteries arise, which are joined together for a short space. The Pulmonary Artery arises on the left side, and soon divides into right and left Branches which go to the corresponding Lungs. The Trunk of the Aorta commences at the right side of the base of the

the Heart, and immediately divides into the right and left Posterior Aortæ, or sometimes the two Aortæ arise separately.

The Right Aorta furnishes the *Aorta Anterior*, that soon divides into two Branches, of which, one is the common Carotid, the other is the Subclavian.

The Carotids are dispersed like those in Mammalia. The Subclavians are also nearly as in Man.

Lizards.—In the *Crocodile*, there are three prineipal Arteries, each with two Semilunar Valves. 1. The Pulmonary Artery on the left side. 2. The Aorta Posterior Sinistra. 3. The Aorta Posterior Dextra. The three Arteries are joined together for some space, as in the former order.

Serpents.—The Lung being single here, and the Extremities wanting, renders the Blood-vessels more simple than in the former orders.

Frog and Salamander.—The Aorta soon divides into two Branches; each of these produces a Pulmonary, a Carotid, and Subclavian, and Arteries similar to the Intercostals, then turns back, and unites with its fellow. The Trunk resulting furnishes the Cœliae and other Arteries, which generally come off from the Abdominal Aorta.

VEINS.

The *Turtle* tribe have two Posterior Cavæ, which, after passing the anterior part of the Liver, are each joined by an Anterior Cava of the same side, formed by the common Trunk of the Jugular and Subclavian.

All go into a Receptacle, which opens into the Right Auricle by a chink bordered by two Valves.

The Pulmonary Veins unite in one Trunk, which goes into a similar Reservoir; and this opens into the Left Auricle, where there is also a Valve.

In the *Lizard* and *Serpent* tribe, there is only one Posterior, but two Anterior Cavæ, which open into a similar Reservoir; and this goes into the Auricle by a chink which has two Valves. The Pulmonary Veins are similar to those of the former order.

In the *Serpents*, there is but one Pulmonary Vein, which goes into the Left Auricle.

In the *Frog* and *Salamander*, the Veins have a distribution similar to the Arteries. There are two Anterior Cavæ and a Cava Posterior, all ending in one Auricle.

OF THE ABSORBENTS.

As in Birds, the Transparency here, joined to the want of Glands, long prevented the Absorbents from being discovered. The structure is similar to that in the Animals of the former class, and, like the Absorbents in these also, they have numerous Valves, but no Glands are found in any part of this system. The Plexus these Vessels so frequently form, are considered by some as supplying the place of Glands.

Here,

Here, as in Birds, the Lymphatics of the Viscera of Digestion and Generation, and those of the Posterior Extremities, join in a Plexus, into which all the other Lymphatics of the Body pass. From this Plexus a short Canal goes out, on each side, which terminates in the Jugular Veins, or in the angles they form with the Subclavians.

In the *Turtle*, the Absorbents of the posterior parts of the Body go to a Plexus, which surrounds the Right Aorta, and then into a Reservoir situated more forwards, under the Left Aorta. From this, two Thoracic Ducts, or rather several principal Branches, arise, which advance to those under the Clavicles. Here they join with the Lymphatics of the Anterior Extremities, and of the Head and Neck, and form two very intricate Plexus. From the Plexus of the right side, two Branches go out, which terminate in the Jugular Vein, near the angle it forms with the Subclavian. The Left sends out but a single Duct, that opens into the angle of the two Veins. The Absorbents under the Peritoneal Coat of the Intestines, run in straight parallel Branches, according to the length of the Bowel; and a good injection shews them to cover almost the whole surface of the Gut. The inner surface is no less plentifully supplied with them, though here they have more the appearance of small Cells.

From the Intestines, they go in company with the Mesenteric Blood-vessels, and form frequent Plexus and communications. At length they anastomose with the Absorbents of the other parts of the Abdomen, and discharge their contents into the Thoracic Ducts.

OF

OF THE ORGANS OF VOICE AND RESPIRATION.

THE *Larynx* of Reptiles, like the Superior Larynx in Birds, is composed of different pieces; but the appearance varies in different kinds of Reptiles, and sometimes in the different sexes of the same Species. There is no Inferior Larynx in this class.

Reptiles have neither Epiglottis nor Papillæ, though, in the *Crocodile*, there are the rudiments of the former. The Larynx of the *Crocodile* has five Cartilages entering into its composition. The Glottis is purely Membranous. The Ligaments of the Glottis are present in all the Animals of the class, but they have neither Lips nor Palatum Molle, and in general no voice. The *Tortoise*, several *Lizards*, and *Serpents*, can only blow. The *Frog* tribe, especially in the time of their amours, are enabled to croak, or, when in pain, they sometimes make a sharp squeaking noise, having a Larynx adapted to these purposes, the vocal Ligaments and Ventricles of the Larynx being of great proportional size. The Males of some Species of *Frogs* have one or two Sacs, either in the Throat or Cheeks, which they inflate, in time of copulation, by means of a Foramen near the chink of the Larynx, opening into each of the Sacs. Here, also, the Rima Glottidis is larger, and the Trachea longer, than in the Female.

The Trachea, in Reptiles in general, is formed of Cartilaginous

Cartilaginous Rings, though with some exceptions, as in the *Crocodile*, *Chameleon*, and *Serpents*. In these last, it has the appearance of being a complete pipe.

The proportion of the Bronchi, compared to the Trachea, is as in Birds; but in *Serpents*, there are large dilatations.

In some of the *Turtle* and *Crocodile* kind, the Bronchi form convolutions; and in some, the Trachea divides so soon, as to appear to be double. In most other Reptiles, the Bronchi are very short.

For the most part, the Bronchi do not divide, and commonly do not enter into the substance of the Lungs, but terminate abruptly in them by one or more large orifices.

The Lungs here, as in Birds, are in the same common Cavity with the other Viscera, but vary more in shape and size than in the two former classes. They form most frequently two oval Sacs, which, in the *Turtle* kind, extend by the sides of the Spine, as far as the Pelvis, and above all the other Viscera. They differ from those of Birds by the greater size of their Cells, and the looseness of their texture.

In the *Turtle*, they are more complicated than in the rest of the individuals of this class, approaching more in their structure to the Lungs of Birds. The Branches of the Bronchi communicate, each by an orifice, with a particular Sac, the walls of which form Polygonal Cells, varying according to the kind of the Animal.

In the *Crocodile*, the Cells are smaller than in the *Turtle*.

In *Lizards*, *Frogs*, and *Serpents*, the Lungs have, at their anterior part, a Cavity, the walls of which are formed

formed of Polygonal Cells, containing still smaller Cells. Posteriorly, they appear to terminate in a simple bag.

Serpents have, for the most part, a single Lung, and here the Trachea terminates directly into it, without dividing into Bronchi.

In the young of some Reptiles, as the *Tadpole*, which are produced in the water, and metamorphose in their first state, in place of Lungs, there are two Bodies, the *Appendices Fimbriatæ*, like Branchiæ or Gills, hanging loose by the sides of the Neck. These are gradually taken into the Thorax, in which they afterwards disappear.

The *Siren Lacertina*, and the *Proteus Anguinus*, are supposed to possess both during life.

In Reptiles, part of the Blood only goes to the Lungs, the rest of the mass going to the other parts of the Body, a circumstance different from what happens in the two former classes.

The Pulmonary Blood-vessels ramify on the Lungs, and serve also as Bronchial Vessels, which are not found here.

In Reptiles in general, where the Ribs are either confounded with the other parts of the Thorax, or are so deficient as to be unable to contribute to Respiration, this process is observed to be effected by the Animal shutting the mouth, dilating the Throat, and producing a void, in consequence of which, the air enters by the Nostrils. The Throat is next contracted, so that it forces the air into the Lungs. Expiration is owing to the action of the Muscles of the Belly. In opening the Thorax of the *Turtle* or *Frog*, the Lungs remain distended for some time, owing to the parts about the Throat acting as a Valve.

OF

OF THE ALIMENTARY CANAL.

HERE, as in Birds, the Viscera of the Abdomen are in the same Cavity with those of the Thorax; of course, the Peritoneum and Pleura are blended together. The former Membrane differs from the latter in Reptiles, in being sometimes of a black colour.

The *Diaphragm* is wanting. The *Alimentary Canal* is very similar to that in Birds. The *Pharynx* and *Esophagus* are nearly of the same diameter, and are wider, in proportion to the size of the Stomach, than in the two former classes, and are rendered still wider than at first sight they appear to be, by being full of Rugæ, which vanish when the Animal swallows.

The *Esophagus* of the *Turtle* is covered with long pointed Papillæ, of a white colour and firm consistence, and turned towards the Stomach, as if to prevent the Food from returning.

In the *Lizard* tribe, the Stomach is of a globular form. In the *Crocodile* in particular, it resembles that of the Gizzard of Granivorous Birds, in the closeness of its orifices, and thickness of its substance.

The Esophagus of *Serpents* is of great size, as they frequently swallow Animals larger than themselves, and often retain them there for days or weeks, allowing them to pass to the Stomach by slow degrees.

The proportional length of the *Intestinal Canal*, compared with the Bodies of Reptiles, is still less than in the

the former class of Animals. In some of the *Turtle* kind, it is about five times the length of the Animal; but in some other Reptiles, as the *Frog*, it is scarcely twice; and in some of the *Serpent* tribe, as the *Coluber Matrix*, it is not equal to the length of the Creature.

The Small Intestines are generally much contracted in their diameter, while the large are as much dilated, though sometimes the reverse, as in the *Hawk's-bill Turtle*.

In *Turtles*, in *Lizards*, in the *Frog* tribe, and *Snakes*, there is a Vermiform Process, but rarely any Cæcum. Almost the whole of this class have a Circular Fold or Valve between the small and great Intestines. The inner part of the Canal has Plicæ, varying in the different kinds, and is lined with a large quantity of Mucus.

In the *Tortoise*, there are no Cells in the great Intestines; but the Canal in this, and some other Animals of the class, is full of Fossulæ.

In *Lizards*, and in the *Frog* and *Toad*, the *Colon* is cylindrical, and much larger than the small Intestines In some of the *Lizards*, as the *Crocodile* of the Nile, the Plicæ of the small Intestines have a zig-zag appearance. In the *Chameleon*, the small Guts equal the size of the Colon; and in the *Crocodile*, the Colon little exceeds the small Intestines.

In *Snakes*, the small Intestines are serpentine, and nearly equal in size with the Colon. They have longitudinal Plicæ, while the Colon has irregular Rugæ.

The Intestinal Canal, in Reptiles, terminates in a Cloaca, which is nearly of the same nature as in Birds.

The

The *Anus*, in some, as the *Tortoise*, is placed under the Tail. In others, as the *Frog* and *Toad*, which have no Tail, it is above the extremity of the Back.

There are some varieties in the situation and attachments of the Mesentery. In the *Tortoise*, it is continued from the Mesocolon, and is not connected directly to the Vertebræ. In *Lizards*, the Mesentery and Mesocolon come off from the Vertebræ. *Serpents* have no Mesocolon Transversum.

Reptiles in general may be said to want the Omentum, yet many *Lizards* have a substance resembling it, charged with Fat; and the Fatty Lobes, attached to the Testicles and Ovaria of *Frogs*, are considered by some as a kind of Omentum, while others think them connected with the parts of Generation, on account of the great increase of bulk at pairing-time.

OF THE LIVER, PANCREAS, AND SPLEEN.

THE *Liver* is present in the whole class, and is proportionally larger than in Mammalia or Birds, extending generally to both Hypochondriac regions.

It is still less divided than in Birds. In some, it has two Lobes; but in many, it has none. It is connected to the Body by the Peritoneum, as in Mammalia.

The colour is commonly bordering upon yellow.

The

The *Gall-Bladder* is also present in all Reptiles, but is of smaller size than in the former class.

In the *Tortoise* and *Crocodile*, it is closely connected to the Liver; in *Serpents*, it lies at a distance from that Viscus.

As in Birds, the Trunks of the Hepatic and Cystic Ducts are separate from each other, though with several exceptions.

Hepato-cystic Ducts go commonly into the Body of the Gall-bladder, or into its Neck, or the beginning of its Duct.

In the *Crocodile*, the Hepatic Duct sends a Branch to the Neck of the Gall-bladder, and unites with the Cystic near its termination in the Intestines.

In the *Turtle*, the Hepatic Duct gives a Branch to the beginning of the Cystic, but the two Canals open separately into the Intestine.

PANCREAS.

The form and situation of the *Pancreas* varies much in Reptiles. In some, as the *Tortoise*, it is triangular; in others, as the *Crocodile*, lobed; and in others, as *Serpents* and *Frogs*, it is irregular, and in the former, is situated on the right side of the Intestines.

The Pancreatic Duct is single in some, and double in others. In some, as the *Salamander Terrestris*, it is inserted before, and in others, as the *Crocodile*, after the insertion of the Biliary Duct.

SPLEEN.

The Figure of the *Spleen* is also very various. In the *Turtle*, it is reniform; in the *Frog* kind, spherical; in *Lizards* and *Serpents*, it is oblong.

It is less intimately connected to the Stomach here, than in the former classes. In some, it is fixed to the left side of that Organ, as in the *Salamander*; in others, to the Anterior Arch, as in the *Chameleon*; or to the beginning of the Intestines, as in the *Tortoise* and *Serpents*. In the *Frog*, it is above the Stomach, between the plies of the Mesentery: In the *Crocodile*, at the left portion of the Intestines.

OF THE KIDNEYS.

THE *Kidneys* here resemble those in Birds, but differ from those in Mammalia, in wanting the Medullary Substance, Infundibulum, and Pelvis. They vary in situation and general appearance in the different orders. In the *Turtles* and *Lizards*, they are in the Abdomen. In *Lizards* strictly so called, they are in the Pelvis. In the *Frog* tribe, they are more forwards. They are covered, on their inferior part only, by the Peritoneum. In *Serpents*, the right is considerably farther forwards than the left. In some, as the *Turtles*, they are collect-

ed into a mass. They are long and flat in *Lizards* and *Frogs*. In the *Serpents*, they form a sort of chain.

The *Ureters* arise as in Birds. In the *Turtle*, they terminate in the beginning of the Urethra, from whence the Urine goes into the Bladder. In many of the *Lizard* tribe, the Ureters terminate in a Bladder, which is of considerable extent, and the Urethra opens into a Cloaca. In the *Crocodile*, the Ureters end in a Cloaca, there being no Bladder. In *Serpents*, each Ureter dilates into a Vesicle, which terminates in a Cloaca. In general, they end in a Bladder or a Cloaca, as the Organ happens to exist. The Bladder, when present, receives the Urine at its Neck, or at the beginning of the Urethra, and opens directly into the Cloaca.

In the Genus *Rana*, viz. the *Frog* and *Toad*, there are two Bags, taken notice of by BLUMENBACH and CUVIER, as Urinary Bladders.

TOWNSON, however, describes the Ureters in these Animals as terminating at the posterior part of the Rectum, as in Birds, while the Receptacles here mentioned, and which are of great size, terminate at its anterior part; and is of opinion, that the fluid they contain is pure water, which he has frequently tasted. He thinks this fluid is absorbed from the surface of the Skin, and serves the same purpose to these Animals, as fluids do to those which take them into the Stomach by the Mouth; that the fluid they eject prevents an inconvenience in leaping.

In the *Turtle* tribe, the bottom of the Bladder divides into two Cornua. The Urethra, which is extremely short, opens into the Cloaca. There are two projections

projections in each side, one pierced by the Ureter, the other by the Vas Deferens. From the above it appears the Bladder exists in the *Turtle;* in many *Lizards*, though not in all; in *Serpents;* and that, in *Frogs*, there are receptacles considered by some as a Bladder, and by others as of a different nature.

Near the Kidneys, but unconnected with them, are two small Bodies, considered by some as *Renal Glands*, by others, as connected with the Organs of Generation. CUVIER looks upon them as a kind of Omentum. In the *Turtle*, they are attached to the Renal Veins. In *Lizards* and *Serpents*, they are in a ply of the Peritoneum, connecting the Ova and Oviducts. In the *Frog*, they are fringed Bodies, like the Testes or Ovaria, and fixed to the Emulgent Veins.

OF THE MALE ORGANS OF GENERATION.

THE situation of the *Testes* in the different orders of this class, is very analogous to that in Birds, being constantly in the Abdomen, in the vicinity of the Kidneys. In the *Turtles*, *Lizards*, and *Serpents*, they are variable in their form, and are fasciculated. In *Frogs*, they are like Granulæ closely connected.

The Epididymis varies in figure and size in the different tribes. As in Birds, the Vas Deferens, coming out from it, terminates in the Cloaca. In the *Turtle*,

the Epididymis is a large Canal, which forms the Vas Deferens, that runs in a flexuous manner to open in the Cloaca at the base of the Penis. In *Lizards*, the Epididymis is detached from the Testicle, and forms a pyramidal Body longer than it. From this the Vas Deferens goes along the edge of the Testicle, in a waving direction, to the Cloaca. In *Frogs*, the Vas Deferens terminates in a Papilla. The Vesiculæ Seminales, and Prostate Gland, are not found in Reptiles in general. The *Frog*, however, has two large Vesiculæ Seminales. In the *Turtle* kind, there is but one Penis. In most *Lizards* and *Serpents*, there are two. In the *Frog* kind, the Penis is entirely wanting. In the *Turtle*, it is very large, and in the relaxed state, is retracted within the Cloaca. It is composed of two Corpora Cavernosa, and has a Groove in its upper surface, instead of an Urethra, the margins of which come so close together when the part is distended, as to form a complete Canal.

The Penis has two Retractor Muscles, which run from the Pelvis to the under side of the Glans.

In *Lizards* and *Serpents*, the Penises are short and cylindrical, and commonly surrounded with bristles. In the relaxed state, they commonly lie in a Pouch under the Skin of the Tail. They are erected by the power of the Muscles of the Tail, and appear at the sides of the Cloaca. Two Retractors from the first Vertebra of the Tail return them to their natural situation in the Pouch.

The *Rattle-snake* and *Viper* have also double Penises; each of which is bifid, and beset with bristles.

In

In the *Crocodile*, the Penis is single, and has a deep Fissure throughout, formed principally of one Corpus Cavernosum.

ORGANS OF APPREHENSION.

Besides the common Organs of Generation, a few Male Animals have Accessory Organs, by which they are enabled to fix upon the Female. Among those of the Reptile tribe are to be observed, the Spongy Ball upon the Thumb, and part of the Palm, of the *Frog* kind. They are composed of hard Papillæ. By means of these, the Male fixes firmly upon the Back of the Female, which he squeezes when in season, and continues there for days, or even weeks, in the water, till the Semen is ejected, which takes place in both sexes about the same time; the two fluids mixing together without any copulation. After the Semen is emitted, the Animals separate from each other, and have no connection till the season of their amours returns

OF THE FEMALE ORGANS OF GENERATION.

ALL Reptiles have two Ovaria, two Oviducts, and one or two Uteri.

The *Ovaria* are commonly more extensive in proportion than in Birds. The *Ova* increase so much in some, as *Frogs* and *Toads*, towards spawning-time, as to distend the Abdomen. The Ovaria are fixed by two long prolongations of the Peritoneum, to each side of the Spine, as far as the Pelvis. Along the loose edge of the Ligament are arranged the Ova, in some like rows of Beads, in others they are in clusters.

The *Oviducts* are Membranous Tubes fixed by the Peritoneum to the sides of the Spine. At their origin, they are delicate; in their course, they become thicker, and, in general, are much longer in proportion than in Birds.

In the *Turtle* kind, there are two Ovaria, two Oviducts, and two Uteri. The Oviducts are thin and delicate, the Uteri thick and fleshy. Each has an opening into the Cloaca, in which, according to BLUMENBACH, there is an evident *Clitoris*.

In *Serpents*, the Ovaria are like rows of Beads, and are composed of yellow Vesicles. The Oviducts are much convoluted, and are connected with double external openings of Genitals, which receive the double Organs of the Male.

Many of this class, as the *Rattle-snake* and *Viper*, are Viviparous, the Ova being hatched in the Cavity of the Oviduct. The *Rattle-snakes* are known to couple in August, when they are frequently observed to make a noise with their Rattle, a substance peculiar to this Animal, and consisting of a number of hollow, horny substances, each linked into the one succeeding it, the first covering the last Vertebra of the Tail. The *Rattle-snake* produces

produces about a dozen of young, commonly in the month of June. In some of these Animals, living *Snakes* have been taken from the Belly, several inches in length.

In *Frogs*, the Ova are clustered up, and extremely numerous. They are found to float loose in the Cavity of the Abdomen, previous to their getting into the Oviducts or Uterine Tubes. The Oviducts, in these Animals, are extremely long and convoluted, appearing like so many Intestines. Each begins at the side of the Heart by an open orifice, and terminates by a large dilatation or Uterus, which ends in a Cloaca.

PART IV.

OF FISHES.

OF THE BONES.

Fishes have in general a Spine, extending from the Cranium to the Tail Fins, and have the Fins at the under part of the Belly articulated with Bones peculiar to them.

The Bones of the *Cranium* are firmly united together by indistinct Sutures. In Osseous Fishes, the Bones are very numerous; but in several of the Cartilaginous, as the *Skate*, the Cranium is chiefly in one continued piece. In general, the Cranium bears a small proportion to the rest of the Head, but is large when compared with the size of the Brain it incloses. It is not marked in the inside by the Brain, not being moulded upon it as in Mammalia.

The Cranium of Osseous Fishes is broad between the Ears, these Organs being contained in the same common Cavity with the Brain. In Cartilaginous Fishes, the Ears are separated by a distinct Septum. Fishes, as Birds, have a partition between the Eyes, which has been compared to a Vomer; and this is generally Membranous, though in some Osseous.

In Fishes of the Cartilaginous kind, the *Under Jaw* differs from that in the Osseous, in not being articulated

articulated with the Cranium, but through the medium of the Bone, analogous to the Os Quadratum in Birds. In each side of the Cranium of Osseous Fishes, as in Birds, there is a great moveable Bone, which supports the Palatine Arches and the Lower Jaw. In the *Squalus* or *Shark* kind, the two Jaws are very moveable. Each is composed of a pair of Cartilages, joined at the fore part. The Upper has two Condyles, by which it is articulated with the Lower Jaw. It has also two small Inter-articular Cartilages. Nearly the same structure is found in the *Sturgeon*.

The *Teeth* of Fishes vary in form, number, and situation, and, strictly speaking, are a set of hard prominent Bodies, placed in some part of the Mouth, or Throat, merely for grasping their prey, and preventing it from escaping, their Food not requiring manducation. Some Species of *Sparus* have Front Teeth, simple, and with Fangs fixed in the Alveoli, almost similar to those in the Human Body.

In general, simple Teeth, with Fangs in the Alveoli, are a continuation of the Alveoli, but differing from them in their structure, and they are covered with Enamel, as in Mammalia. In some, as the *Squalus*, the Teeth are also simple, but joined only to the Gums, and grow in the manner of Epiphyses. In some, the Teeth are conical and blunt; in others, flat and round, or simply round; or some have them sharp, and in the form of wedges.

In the *Shark*, the Teeth are very numerous, but without Fangs, and are placed in rows. The front row only is perpendicular, and exposed; the rest are smaller,

er, and turned back, and covered by the Gums, but come forward when any of the front row are lost, so as to supply their place.

The situation of the Teeth is very variable. They are placed in the Jaws,—or in the Palate,—or in the back part of the Septum Narium,—or in the Bone which supports the Tongue,—or in that which supports the Branchiæ,—or at the beginning of the Esophagus; and named, from their situation, *Mandibular*, *Palatine*, &c.

Some, as the *Salmon* and *Pike*, have Teeth in all parts of their Mouth. The *Squalus Pristis*, or Saw-fish, has Teeth in both sides of the sword-shaped Bone in front of the Head. In some, the Teeth are only wanting in certain parts of the Mouth. The *Perch* has them in every part of the Mouth, excepting the Tongue. The *Sturgeon* has no Teeth.

The number of the *Vertebræ* is also very variable in this class. In Osseous Fishes the Vertebræ of the Neck are wanting, or there are not more than three or four. In the *Skate* kind, they are united into one piece. The Vertebræ of the rest of the Spine varies extremely, being from about 20 to upwards of 100. Some *Sharks* have above 200. In some, they are cylindrical; in others, angular; in others, flattened. They are articulated by their Bodies, having no oblique Processes.

The Bodies of the Vertebræ are hollowed out into conical cups, containing a glairy matter. The edges of the cups are joined to those of the contiguous Vertebræ through the whole length of the Spine, by Cartilages composed of concentric Fibres. The last Vertebra is generally

generally triangular and flat, and lies in a vertical direction, corresponding with the Fin of the Tail.

Of the *Spinous Processes*, one set is placed above, and another below the Bodies of the Vertebræ. Between the Bodies of the Vertebræ and Roots of the Superior Spinous Processes, is the Canal for the Spinal Marrow; while there is frequently a passage between the Bodies and Inferior Spinous Processes for the great Blood-vessels.

The Vertebræ are connected to the Head, in Osseous Fishes, by a single Condyle under the Foramen Occipitis, while, in the Cartilaginous kind, there are two Tubercles.

Fishes have no proper Thorax, the Abdominal Viscera occupying the cavity of the Trunk, which is formed by the Spine and the Ribs where they exist, for few of the individuals of the class possess a Sternum.

The number and magnitude of the *Ribs* vary much here. In some, the size is considerable; in others, as the *Herring*, they are like small bristles; in many, they are forked through the greater part of their length; in some, double throughout. In most Fishes, the Ribs are articulated with the Bodies of the Vertebræ; in some, they are only fixed to the Transverse Processes.

The *Anterior Extremities* of Fishes are their Pectoral Fins, composed, as Fins are in general, of Osseous Rays, and each of these of several articulations, all of which are joined by a common Membrane. They are generally fixed to a Bony substance, which is the only thing analogous to the Scapula, and which is articulated with the upper and back part of the Cranium. In the

Skate

Skate kind, they are fixed to the Vertebræ, and give to these Animals a rhomboidal form. In Osseous Fishes, the Pectoral Fins form an angle with the Body, and move horizontally backwards and forwards; but in the *Raja*, *Squalus*, &c. they are in the same horizontal plane with the Body, and move less or more in a vertical direction.

The Abdominal Fins are connected to Bones, which may be compared to the Ossa Innominata, as the Pectoral are to the Scapulæ.

Besides the Bones mentioned above, some Fishes possess Bones which are placed among the Muscles, and have the name of *Ossicula Musculorum* Artedi.

OF THE MUSCLES.

The *Muscles* of Fishes are distinguished from those of the Animals of the former classes, by receiving less Blood, of course being paler in their colour, and by being more uniformly disposed into Layers, and, in general, by wanting Tendons.

In Osseous Fishes, the greater part of the Muscles are placed upon the lateral parts of the Body, by which they enable the Animal to move readily to either side.

The spaces between the Ribs are occupied by Muscles somewhat

somewhat similar to the Intercostals; but the Ribs are also affected by the large lateral Muscles of the Body, which are likewise fixed to them. In the greater number of Fishes there are no Muscles peculiar to the motions of the Head, this being done chiefly by the Lateral Muscles of the Body.

The Fins on the under part of the Body, are moved in various directions by small Muscles peculiar to themselves. Those in the Back have Muscles in pairs, placed before and behind the Fins; one pair passing from the nape of the Neck to the Fin, another lying between the Fin and the Tail. Where there are two Dorsal Fins, there is no additional pair of Muscles placed between them.

In the *Raja*, there are Muscles for moving the Head upon the Body, and others by which the Snout is moved upon the Head. The *Skate* has two thick beds of Muscles on the Body, one placed above, and another below; and these are formed into numerous Fascieuli, which, like the Cartilaginous parts of the Fins, have a radiated appearance.

OF THE INTEGUMENTS.

THE *Integuments* here have the same number of Layers as in the former class of Animals. The *Cuticle* is strong and thick, and is covered by the *Scales*, which are laid on

on each other like tiles on a house, and exist less or more in Fishes in general. The Scales are found to cover the Cuticle, as the Hair, &c. does in other Animals, but are not, like these substances, frequently changed; instead of which, they are found to be permanent, and are said to increase in number as the Animal becomes older.

The *Cutis* is very thick and strong in the *Sturgeon*, and in some of the *Skate* and *Shark* kind; but in Fishes with large Scales, as the *Cyprinus* and *Sparus*, it is of a thin and delicate texture.

In certain Vertebral Fishes, as the *Carp*, there are some Muscular Fibres attached to the Skin of the Back, forming a kind of *Panniculus Carnosus*.

In Fishes, as well as in other cold-blooded Animals, there is no *Fat* under the skin. In some, as the *Salmon*, there is an oily fluid; in others, as the *Moon-fish*, a substance of great thickness, like Lard, under the Skin, but it is found to be of the nature of Albumen.

The Integuments of Fishes have no vessels carrying red Blood, and but very small Nerves; of course, are well fitted for protecting the tender parts within.

Upon the surface of Fishes, particularly in such as live in salt water, there are *Ducts*, varying in number according to the kind, which pour out a Mucus to defend the Skin from the penetrating effects of the water. Those destitute of distinct scales, as the *Skate* tribe, have this Mucus in greatest abundance.

In the *Raja* and *Squalus*, a set of transparent Ducts originate from a point on each side of the Animal, directly over the angle of the Jaw, and a little to the outer

and

and back part of the Eye. From this, as a centre, the Ducts issue in Fasciculi, and extend in Radii of different lengths, between the Skin and the Muscles. They are shut at their origin, have no visible Glands, nor have they any evident communication with each other.

Each has an opening of considerable size upon the surface of the Body, where they pour out clear slime in large quantities, to defend the Skin, which, in Animals of this kind, is less scaly than in others.

Upon the beginning of these Canals, where they issue from a centre, a large Nerve, the third Branch of the fifth pair, is dispersed in radiated Branches, which become suddenly transparent, and vanish in the Coats of the Ducts.

Upon the under surface of these same kind of Fishes, there are also Mucous Ducts, of a similar nature with the former, but more irregular in their course. Besides the Ducts mentioned above, there are others, much larger, upon the inferior or ventral surface, which likewise discharge Mucus for the defence of the Skin. They are situated at the sides of the Mouth, and upon the Lateral Fins, and take a serpentine direction.

In the *Torpedo*, the Mucous Ducts are less in number than in the *Skate*, &c. and they only receive part of the numerous Filaments of Nerves which go to the former Ducts, the larger portion being spent upon the Electric Organ of this Animal.

In Osseous Fishes, as the *Cod*, *Haddock*, &c. the Mucus comes from a Linea Lateralis, or Duct on each side of the Body and Head, and extending as far back

as

as the Tail Fin. Upon the Head, the Duct divides into Branches, which spread out upon the two Jaws. From this Duct a number of short Tubes arise, and terminate by openings upon the surface of the Skin. CUVIER describes these Ducts as arising from two Glands placed on the Head, above each Orbit.

OF THE BRAIN, &c.

THE appearance of the *Brain* differs much in the different Species. It is always remarkably small in proportion to the size of the Body, though the Nerves are as large, when compared with the parts on which they are distributed, as in the former classes.

The Brain here never fills the Cranium, there being always a large space occupied by a salt fluid, contained in loose Cellular substance, which surrounds the Brain, and supplies the place of the Tunica Arachnoidea.

The Brain, in Fishes, somewhat resembles that in Birds, only the posterior bear a greater proportion to the anterior parts, and there is often a Tubercle behind, forming a kind of second Cerebellum, and which is peculiar to Fishes.

The Brain, in general, is divided into Cerebrum and Cerebellum, and these have their Ventricles somewhat as in Mammalia. The Lobes are more numerous than in

in the former class, but there is great variety in different Fishes.

The Cerebrum constantly forms two Lobes or Hemispheres, which are laid by the sides of each other, and are smooth and without convolutions. The Cerebellum is in one Lobe, and larger in proportion than the Hemispheres, often surpassing them in size.

Each of the Hemispheres has a Ventricle, with a kind of Corpus Striatum; and there is also something like a Third and Fourth Ventricle, as in Mammalia.

The Thalami Optici are constantly situated, as in Birds, under the Hemispheres, and, as in them also, each contains a Ventricle.

There are no distinct Tubercula Quadrigemina, unless Tubercles situated under the Hemispheres, in some Fishes, are taken for such.

The *Nerves*, as already noticed, do not bear proportion to the size of the Brain, but to that of the parts to which they are destined. They differ from the Nerves of the Animals of the former classes, in having no Ganglia, though in the Genera *Cyprinus* and *Gadus*, something like Ganglia are found in the Olfactory Nerves.

In certain Fishes of the Genus *Gadus*, as *Cod*, *Haddock*, and *Whiting*, there are numerous small roundish Bodies, contained in little Vesicles on the surface of the Brain, on the anterior extremity of the Spinal Marrow, and on some of the principal Nerves, and within the Skin covering the Fins. These are described by DR MONRO in his Work on Fishes, but their use is unknown.

The *Olfactory Nerves*, in certain Fishes, as the *Skate* and *Shark*, are so large at their origin, as by some to have been considered the proper Brain, or at least its Anterior Lobes. At their roots, each forms a large Bulb, from which the Nerve passes towards the Nares. In some, the Nerve is at first slender, and afterwards forms a large Ganglion; in others, it is thick and short, and surrounded with Cortical Substance. It terminates by a Ganglion, which is separated from the Nostril by a Cribriform Membrane, which gives passage to the Nerves into the Nose.

In Osseous Fishes, the Olfactory Nerves are long and slender, in some surrounded by Cartilage, in others by Membrane. The Genera *Cyprinus* and *Gadus* have, at the Nasal extremity of the Nerve, a spherical Ganglion, composed in part of Cineritious Substance.

The *Optic* Nerves, in the generality of Fishes, particularly in those of the Osseous kind, cross each other without being incorporated. They are attached merely by Cellular Substance, the Right Nerve going to the Left Eye, and the Left Nerve to the Right Eye. In some Fishes, they are Fibrous; in others, they have a laminated or plaited appearance.

The *Third* and *Fourth* Pairs are dispersed nearly as in the former classes of Animals. The *Fifth* comes off from Tubercles behind the Cerebellum, which, in the *Raja*, are remarkable for their great size. Each divides into three Branches, as well as in the Human Body; and these go to the outer part of the Nose, to the sides of the Mouth, and to the Face in general.

In

In the *Skate*, the third Branch vanishes suddenly upon the Mucous Ducts which issue, as from a centre, at the outer and back part of the Eye. The *Sixth* Pair is distributed as in other red-blooded Animals. Of the *Seventh* Pair, the Portio Dura is large in Cartilaginous Fishes, and comes off from the Brain quite distinct from the Auditory Nerve. The Portio Mollis lies so near the Fifth Pair, as to appear to be a Branch of that Nerve. In Cartilaginous Fishes, as the *Skate*, it passes into the Ear by a single Foramen; in the Osseous kind, as the *Cod*, where the Ear is in the same Cavity with the Brain, the Nerve is dispersed directly upon that Organ. The *Eighth* Pair is remarkable on account of its great size, and its distribution. It is divided into three portions, one of which runs directly to the Branchiæ. The second goes to the Muscles of the Tongue, and to the Esophagus. The third is a large Nerve, which extends under the Skin as far as the Tail Fin, upon which it terminates. The *Ninth* Pair appears to be wanting. The Great Sympathetic Nerve is also found here, but extremely slender. It unites with the Vertebral Nerves, but this, like the other Nerves of Fishes, has no visible Ganglia, excepting those in the Olfactory Pair in certain Fishes, as the *Gadus*, &c.

The Spinal Marrow, in the Animals of this class, is remarkable for its great size when compared with the Brain. The Cervical Nerves are few in number, and in some Animals there are none, the Vertebræ of the Neck, in such Fishes, being wanting. When present, they are chiefly dispersed about the Throat and Pectoral Fin.

There is no Diaphragmatic Nerve, though one of the first Vertebral Nerves is spent upon the partition between the Cavity of the Branchiæ and that of the Abdomen. The Dorsal and Lumbar Nerves are all distributed in the Intercostal spaces. The Sacral and Caudal Nerves are not very distinct; they are lost in the posterior part of the Body and the Tail Fin.

Besides the Nerves mentioned above, it is here thought proper to take notice of those which belong, in certain Electrical Fishes, to that curious apparatus which performs the office of a Leyden Jar, or Electrical Battery. The *Raja Torpedo*, *Gymnotus Electricus*, and *Silurus Electricus*, are the only Fishes in which Electrical Organs have been discovered: though one Species of the *Tetraodon*, and one of the *Trichiurus*, possess the same electric property. In the three first-named Animals, the Electric Organ consists of Aponeurotic Cells, filled with a fluid like the Glaire of an Egg. Upon this substance large Nerves are distributed; but the proportional size and the structure of the Cells, the origin, number, and relative magnitude of the Nerves, vary in the three different Species.

The Electrical Organ of the *Torpedo* bears a large proportion to the Body of the Animal, and is situated between the Head, the Branchiæ, and great Cartilage of the Pectoral Fin in each side; or in that part from whence the Mucous Ducts issue as from a centre, on the Back of the *Skate*. It extends in a perpendicular direction from the Dorsal to the Abdominal Skin. When the Integuments are raised, the Organ appears, consisting

consisting of some hundred pentagonal or hexagonal columns, closely compacted, and giving somewhat the appearance of a Honeycomb. The Columns are formed of transparent Laminæ, and are connected together by transverse Tendinous Fibres. They are divided by a great number of thin partitions placed over each other, but leaving small spaces between them, which are full of a glairy liquor. Minute Blood-vessels are dispersed upon this Organ. Its Nerves are of extraordinary size, and are furnished by four principal Branches. The first is the Inferior Maxillary, or third portion of the Fifth Pair, and corresponds with that which, in the Back of the *Skate*, sends a very large Nerve to the origin of the Mucous Ducts. The other Nerves are from the Eighth Pair, and come to the Electrical Organ after supplying the Gills.

The whole of this remarkable substance is found to correspond in its effects with those of an Electrical Machine. The upper and under surfaces of the Animal are in the *plus* and *minus* states of Electricity, and the shock is given at the will of the Creature; but differs from that coming from an Electrical Apparatus, in producing neither light nor sound.

The Electrical Organ, in the *Gymnotus*, is more developed than that of the *Torpedo*. It composes a great part of the thickness of the very large Tail, and extends from within a little distance of the Head to the posterior extremity of the Animal. It is divided into four portions, called by MR HUNTER, *Great* and *Small Organs*. The Great Organs are placed above the Small

at each side of the Tail, of which they form about two inferior thirds of the thickness, the Caudal Muscles composing the principal parts of the remaining third. Each of the Columns is intercepted by a great number of Laminæ, forming the whole into so many Cells, which are here of a rhomboidal form. They receive their principal Nerves from the Spinal Marrow; some of less consideration coming from the Sympathetic Pair.

Of the *Silurus*, the Organ covers the greater part of the Body. It begins at the Head, and extends to near the Tail, and forms a thick Stratum anteriorly, but becomes thinner as it approaches the Caudal extremity. It receives its Nerves from those portions of the Eighth Pair which extend, in other Fishes, along the lateral parts of the Body; but these are much smaller in proportion than in the *Torpedo*.

OF THE EYE.

THE *Eye* of the Animals of this class is proportionally larger than in the two former, that of the *Cod* greatly exceeding the size of the Human Eye.

In Fishes, as in the *Cetacea*, while the posterior part of the Ball is convex, the anterior is quite flat, the water in which they live refracting the rays of light, and

and supplying the place of the convexity of this part of the Eye.

In some Fishes, as the *Skate* and *Shark* tribe, the Eye rests upon a stalk of Cartilage, or expands behind into a kind of Tubercle, which allows the Muscles to act with more advantage upon it. In other Fishes, it rests upon Gelatinous Matter in form of a Cone, contained in loose Cellular Substance.

Fishes are destitute of Eye-lids; but, to defend this Organ from injury, the Tunica Adnata is stronger than in Mammalia and Birds, and passes immediately over it without forming any doubling. It may be separated readily from the Tunica Sclerotica and the Cornea. Upon the inner or back part of the Cornea is a delicate Membrane, termed *Tunica Aquea*, which incloses the Aqueous Humour at the fore part of the Eye; this can also be easily separated.

In some, as the *Eel*, the Tunica Adnata allows the Cornea to move behind it, in the manner it does in *Serpents*, &c.

The Cornea is not so firmly connected to the Sclerotic as in Mammalia; it is easily separated from the Sclerotis, which appears then open at the fore part of the Iris.

Most Osseous Fishes, as the *Salmon*, *Mackerel*, &c. have, at each corner of the Orbit, a Vertical Veil, which covers a small part of the Eye.

The Tunica Sclerotica is Cartilaginous, semi-transparent, and lined with a delicate Membrane, which is commonly of a black colour.

Fishes have no Tapetum on the Choroid Coat, the

inner Layer of which, or *Tunica* RUYSCHIANA, is black, but in the *Skate*, *Shark*, &c. the bottom of the Eye is of a silver colour, from the Choroid Coat appearing through its inner lining, which is here transparent.

The outer Layer of the Choroides, or proper Choroid Coat, is white or argent, and Vascular. From the inner Layer, a Vascular Funnel-shaped Membrane arises, the *Campanula* of HALLER, which goes to the Lens, and has been considered as analogous to the Marsupium of Birds.

Between the two Layers of the Choroid Coat, in the Osseous Fishes, but not in the *Skate* and *Shark* kind, there is a Body, termed *Corpus Glandulosum*, or *Glandula Choroidea*, of a brilliant red colour. It is in form of a Horse-shoe, or, in some, approaches to a circle. It is considered either as Muscular, and serving to make the Eye accommodate itself to objects at different distances, or Glandular, and secreting some of the Humours.

The Corpus Ciliare is indistinct, and Ciliary Processes are generally wanting in Fishes.

The Iris is intimately connected with the Choroid Coat, and possesses brilliant colours in different Fishes.

In the *Skate*, the upper part of the Iris has a palmated Process or Curtain, termed *Operculum Pupillare*, which the Animal occasionally lets down to cover the Pupil.

Of the Humours of the Eye, the Aqueous is so small in quantity, as to be seen with difficulty, the deficiency being supplied by a spherical Lens, and the denser element in which the Animal lives. The Lens is, besides, observed to be not only rounder, but also more dense than

than in Land Animals, the more completely to refract the rays of light coming from the water. It is remarkably large in most Fishes, but the Vitreous Humour is proportionally small.

The Optic Nerves, in *Osseous* Fishes, cross each other without any intermixture of Medullary Substance, and go to the opposite Eyes. The crossing is less apparent in the Cartilaginous kind. In the *Skate*, the Right Nerve passes through an opening in the Left. In general, the Body of the Nerve is Fibrous, as in other Animals; but in some, as the *Sword-fish*, it is formed of Layers put together like a Fan, and inclosed in the Dura Mater.

In many Fishes, as the *Raja* and *Squalus*, the Nerve, getting into the Eye, forms, as in Reptiles, a small Tubercle, from the edges of which the Retina grows; but in others, as the *Salmon*, *Herring*, &c. the Nerve, as in Birds, after perforating the Choroid Coat, forms two white lines, which give origin to the Retina.

The Retina has a peculiar appearance in Fishes, being formed of two Layers, the external of which is Medullary, and the internal Fibrous.

The Muscles, in this class of Animals, as in the former, are six in number, four straight, and two oblique; but both of the latter come from the anterior and under side of the Orbit. One is inserted at the under, the other at the upper part of the Eye, without the intervention of a Pulley, as in Mammalia.

OF

OF THE EAR.

The *Organ of Hearing*, in Fishes, is as distinct as in other Animals, and much greater in proportion than in Mammalia or Birds. Partaking of the growth of all the other parts, it increases in size, in proportion to the age and bulk of the Animal.

The different parts of the Ear, in this class, are more readily traced than in the former, not only on account of the size, but also the looseness and softness of the parts.

The Ears are divided into two kinds, according as the Fishes are Cartilaginous or Osseous, the former possessing certain parts which are not found in the latter.

Of the *Cartilaginous Fishes*, a large *Skate* is here taken as an example.

A little before the joining of the Head and Spine, there are two Foramina, placed obliquely, and at a little distance from each other, capable of admitting a large Hog's bristle, which are the Mouths of the External Auditory Passages. These are detected by pressure, when a small quantity of milky-like liquor is found to issue from them.

Each Foramen leads to a winding Canal, or a kind of Concha, almost of a circular form, lying under the Skin, and containing some chalky fluid.

The bottom of this is of a Funnel shape, and ends in

in a narrow passage, or Meatus Auditorius Externus, which pierces the Cranium. This goes directly to a Sac belonging to the Labyrinth or Internal Ear, there being no Membrana Tympani in Fishes.

The Labyrinth is situated at the back and outer part of the Brain-case, a little behind the Eye, and is found by cutting almost horizontally, but a little downwards and outwards, through the substance of the Cranium; the Animal being supposed to be placed in the prone situation.

Between the Labyrinth and Brain-case, there is a distinct partition, which communicates only by the Meatus Auditorius and the passages for the Nerves.

The Internal Ear consists of a Membranous Labyrinth, contained in a Cartilaginous one, hollowed out in the substance of the Cranium.

The Cartilaginous Labyrinth somewhat resembles the Membranous in form, and is composed of an Antrum and three semicircular, or rather circular Canals, all of which are lined with a Perichondrium; but the Cartilaginous parts greatly exceed the Membranous in size.

At the inner side of this Cavity are the passages for the Nerves; at the outer is a kind of Fenestra Ovalis, which is shut only by a Membrane covered by the Skin.

The Membranous Labyrinth is formed of a large triangular Sac, slanting obliquely outwards and downwards, and is analogous to the Sacculus Vestibuli in Mammalia. It has also three semicircular Canals, in each of which there is an Ampulla, more conspicuous than in most other Animals.

The

The Sac contains a transparent viscid fluid, and has a soft starchy or chalky-like substance placed in its bottom, the whole apparatus supplying the place of a Vestible and Cochlea.

There is no Tympanum nor Eustachian Tube in this class of Animals.

At the anterior part of this Sac, there is a smaller one, compared to the Cochlea of Birds, and behind, there is another still smaller, each communicating with the large Sac, and filled with the same kind of glairy fluid and chalky substance.

The Membranous semicircular Canals are something similar, in their texture and transparency, to the Capsule of the Crystalline Lens in Mammalia, and are filled with the same kind of glairy liquor as that found in the Sacs, but do not contain any of the Cretaceous matter.

One of the Canals passes downwards and outwards, another outwards and backwards, and both approach to a vertical situation. The third is placed between the other two, and runs nearly in a horizontal direction.

The anterior and middle Canals join into a common one, which communicates with the anterior small Sac by a short tube. The posterior Canal opens into the large Sac by a Duct of considerable size, but has no direct communication with the other two Canals.

The Membranous Labyrinth is suspended in the Cartilaginous one by Vessels and Nerves, and by Cellular substance containing a watery fluid.

Upon the Sacs and Ampullæ of the Canals, large Nerves are dispersed, which belong to Trunks analogous

gous to the Fifth, and Portio Mollis of the Seventh Pair, but chiefly to the latter.

When the Animal is laid in the supine situation, and the Cartilage, which, in the natural state, lies under the Ear, is properly separated, Branches of the Portio Mollis are observed to form Penicilli upon the Ampullæ, and an intricate Plexus on the Vestible, and small Sacs projecting from it, which are fully exhibited in DR MONRO's Work on the Eye and Ear.

In *Osseous Fishes*, the Organ of Hearing has a general similarity with that of the former kind, but differs in several particulars.

No Meatus Externus has been found. The Internal Ear is inclosed in the same common Cavity with the Brain; the Bones at the sides of the Brain only forming some Processes, to which the Labyrinth is connected by Cellular Substance and Vessels, and by some Osseous and Cartilaginous bridles. In some parts, also, Membranes intervene, but there is no distinct partition. There is a Sac or Vestible of considerable size, simple in some, divided in others, containing a viscid fluid, and one, two, or three Cretaceous stones, the number varying according to the kind of Animal.

The stones have a particular figure, are of various sizes, and are white and hard like Porcelain. They are suspended in the Pulpy fluid by a beautiful Plexus of Nerves, and have been regarded by some as serving the same purpose with the Ossicula Auditus in Mammalia.

There are here, also, semicircular or Circular Canals, the outer Osseous, the inner Membranous; and, as in Cartilaginous

Cartilaginous Fishes, the outer set greatly exceed the inner in size.

The length of the Osseous Canals varies in different Fishes; part of them forms a sort of Pulley, over which the Membranous Canals pass.

The Membranous Canals vary also in length, but have in general the same kind of communication with the Vestible, and with each other, and form the same kind of Ampullæ, as in Fishes of the Cartilaginous kind.

Nerves corresponding with those in the *Skate* are also dispersed upon the Sac and Ampullæ; but the Nerves pass to the Labyrinth without perforating the Bones.

OF THE NOSE.

THE *Organ of Smelling* is extensive in Fishes, though it has no connection with the Organs of Respiration; and is supposed to be acute, being a principal means by which they are enabled to search for their Food.

The Nostrils, in Osseous Fishes, are generally divided by a cross Membrane, which gives the appearance of being double on each side. Some Muscular Fibres are found about the Nostrils, which admit of a small degree of dilatation or contraction occasionally, but the motion is not very evident.

In

In the *Raja*, *Squalus*, &c. among the Cartilaginous kind, the Nostrils communicate with the Mouth by a Chink of considerable magnitude.

In Osseous Fishes, instead of turbinated Bones, there are numerous Membranous Laminæ, running in a radiated manner from a Tubercle at the bottom of the Nose; but in the *Raja*, *Squalus*, and several others, there is an elegant plaited Membrane, in place of Ossa Spongiosa. This is disposed in crescentic folds, somewhat in a parallel direction to each other, and placed on each side of a principal Lamina, which extends from one end of the Nostril to the other.

There is no Foramen Incisivum in Fishes, there being, strictly speaking, no Nasal Cavity here.

Upon the Laminæ above mentioned in the Nose, the Branches of the Olfactory Nerves are expanded, supplying the whole internal surface of that Cavity, and there forming a Retina, as in the Eye; but the Filaments are more distinct.

OF THE TONGUE.

THE *Tongue*, in Fishes, is in general of such a firm Cartilaginous nature, that some have doubted how far it is to be considered as an Organ of Taste. The Skin covering it is commonly very thick, like that of the rest of the Mouth. It exhibits no distinct Papillæ.

pillæ, but, in many Fishes, is so garnished with a kind of Teeth, as to appear to render the surface almost insensible.

It is generally supported, as in Birds, by an Os Linguale, or a Cartilage which also supports the Branchiæ. This, in some, is small; in the *Conger*, it runs the whole length of the Tongue.

The *Raja*, *Squalus*, and *Lamprey*, can scarcely be said to have a Tongue, the parts being quite smooth and even.

Salivary Glands.—Fishes in general are destitute of Salivary Glands. In the *Carp*, there is an irritable Glandular Body, situated on the Palate, and considered by some Authors as supplying the want of these; by others, it is looked upon as a sort of Tongue. In the *Raja* and *Squalus*, there is a mass of small Granulous Glands upon the Membrane of the Palate, which have been considered as analogous to the Mucous Glands in other Animals.

OF THE HEART AND BLOOD-VESSELS.

THE *Heart* of Fishes is situated in a Cavity between the posterior parts of the right and left sets of Gills, and is small in proportion to the Body of the Animal. The *Pericardium*, in many Fishes, is merely the lining of the Thoracic Cavity. The Heart, as in *Frogs*,

Frogs, consists of a single Auricle and a Ventricle, which correspond with the right side of the Heart of warm-blooded Animals. The *Auricle* is commonly larger than the Ventricle, but thinner in its walls. It receives the Blood from the Body, and sends it to the *Ventricle*, in the Mouth of which there are Valves, which vary in number in different Fishes. The Ventricle is sometimes round, at other times triangular, but more frequently of a tetragonal form. Its sides are generally thick, and have Columnæ Carneæ running in different directions. It opens first into a *Bulb* or *Pedicle*, which is very conspicuous in the *Cod* and *Salmon*, where it is of a pyramidal form. In the *Skate*, it has a cylindrical appearance. In this Animal and the *Sturgeon*, there are Valves at the entry, and also at the further extremity of the Pedicle. In the *Cod*, *Salmon*, &c. the Valves are only at its origin.

Principal Blood-vessels.—The distribution of the Blood-vessels differs considerably from that of the Animals of the preceding classes. They have a smaller proportion of red, but a much greater number of colourless Vessels. The Branchial Artery is continued from the Pedicle, and is entirely spent upon the Gills. In the *Skate*, it advances under the Cartilage which unites the inferior extremities of the Branchial Arches, and soon gives off a Branch to each side, that subdivides into three others, to be dispersed upon a corresponding number of Posterior Branchiæ. The Trunk afterwards proceeds till it gets opposite to the two Anterior Branchiæ, and then divides into a

couple of Branches, which are distributed upon these Organs.

In other Fishes, as the *Cod*, *Salmon*, &c. this Artery sends off Branches in a similar manner, but only four in number in each side, corresponding with the number of the Branchiæ.

From the Gills the Blood returns, and is sent to all the parts of the Body by a set of *Arterious Veins*, or Branches, which are found to be of the same thickness and strength with those of the Branchial Artery. In the *Skate* tribe, these Vessels, in number equal to that of the Gills, pass back under the Cartilage of the Neck, and join their fellows of the opposite side, to form the Aorta. Before they unite, they give Branches to the Neck, Head, &c. and furnish the Coronary Arteries of the Heart.

The beginning of the Aorta sends a large Artery to each of the Lateral Fins, and parts adjacent, and soon after, the Cœliac and two Mesenteries to the Chylopoietic and Assistant Chylopoietic Viscera; then Arteries to the Organs of Urine and Generation, and two large Branches to the Posterior Fins. The continuation of the Aorta goes at last to the Tail, protected in a Canal in the inferior part of the Vertebræ.

In other Fishes, the Aorta is formed by only four Branches on each side, corresponding with the number of the Gills. In some Fishes, as the *Sturgeon*, the Aorta is almost entirely concealed in a Canal in the Bodies of the Vertebræ.

Veins.—The Veins, in this class of Animals, are extremely thin in their Coats. They form receptacles for the

the Blood, being much larger in their course than at their termination in the Heart. At the opening of some of the Veins in the Heart, or where Branches end in some of the principal Trunks, there is a sort of valves, which prevent the retrograde motion of the Blood.

From the different parts of the Body, the Blood is returned to the Heart by one or two Posterior Cavæ, situated at the sides of the Aorta, by the Hepatic Vein, and by two Anterior Cavæ, one at each side of the Breast.

OF THE ABSORBENT VESSELS.

THE Mouths of the *Absorbents*, in Fishes, contrary to what is found in other Animals, can in some measure be seen, especially in some of the *Raja*, as the *Skate*. If a coloured fine injection be thrown into one of the principal Trunks, it passes out by numerous streams, especially on the back of the Animal.

The Absorbents, in this class of Animals, are somewhat flat, and have the appearance of having Joints or Valves; but no real Valves are found in any part of them, excepting at their termination in the red Veins, for an injection can be made readily to pass from the Trunks to the extreme Branches. They are also quite destitute of Conglobate Glands, and the Lacteals contain transparent Chyle.

In the *Skate* kind, the Absorbents are proportionally much larger, compared with their Blood-vessels, than in the former classes.

They have frequent communications with each other, and often by transverse Canals; but in place of forming Thoracic Ducts, they unite into Right and Left Plexus, which go to the corresponding sides of the Body.

The principal Absorbents of the Chylopoietic Viscera run near the large Branches of the Cœliac and Mesenteric Blood-vessels, and the principal Lymphatics of the Assistant Chylopoietic Viscera attend the larger Vessels belonging to these parts.

Besides the Plexus which these form, there is one of a singular nature on the Curvature of the Stomach; it has a Cellular or Cavernous appearance, which does not occur in any other part of the Body.

Into the Visceral Plexus all the other Absorbents of the Body pass; the Lymphatics of the inferior parts, and of the Organs of Urine and Generation, run up to them. Those of the Trunk go inwards, and those of the Head, Heart, and Gills, form chiefly a single Trunk, which descends.

From these Plexus, a Trunk in each side of the Body ends in the Subclavian Vein at the joining with the Internal Jugular, where the fluids are prevented from returning by a pair of Valves.

In the *Cod*, *Salmon*, and other Osseous Fishes, there are five principal Vessels, which are more conspicuous than the rest; one runs directly along the middle of the Belly, from the Anus to the Head, and receives the Lymphatics from the parts of the Body near it; another along

along each side of the Fish, near the great Mucous Duct, and belongs to the Body and Tail. One, deep-seated, belongs to the parts about the Spine and upper portion of the Head, and receives Branches from the Dorsal Fins and parts of the Back; and a large Vessel, or Plexus of Vessels, belongs to the Gills, Mouth, Brain, and Organs of the Senses.

The principal Lacteals run in the Mesentery, near the Arteries, communicating there by innumerable transverse Canals, but are smaller in proportion to the Blood-vessels than in the former tribe of Fishes.

At the Anterior part of the Abdomen, the Lymphatics of the Stomach and Assistant Chylopoietic Viscera are added to the Lacteals. The conjoined Vessels pass to a large Reservoir at the right side of the posterior extremity of the Esophagus. From this Reservoir, large Absorbents, sometimes considered as analogous to Thoracic Ducts, go forwards, receiving, in their course, the Lymphatics of the Organs of Urine and Generation, and run into a large Cellular Receptacle on each side, situated chiefly between the Cartilage analogous to the Clavicle, and the undermost Gill. These Receptacles receive also the Lymph from the five principal Vessels mentioned above, and from the various other parts of the Body. The two Receptacles communicate together by cross Canals, which run principally behind the Heart and Esophagus.

In the *Salmon*, each Receptacle sends out a Duct, which terminates in the anterior extremity of the Posterior Cava of that side, at the fore and outer part of the Internal Jugular Vein.

At the termination of the Ducts there are doubled Membranes, answering the purpose of Valves.

In the *Cod*, the Receptacles contain the Muscles of the Gills, their Nerves, and the Cornua Anteriora of the Air Vesicles.

OF THE ORGANS OF RESPIRATION.

INSTEAD of Lungs, Fishes are furnished with Branchiæ, or Gills, or a kind of inverted Lungs, placed behind the Head, and communicating with the Throat.

There are, in most Fishes, four Gills in each side, resting on an equal number of arched portions of Cartilage or Bone, connected to the Os Hyoides; and these are fixed to the Head, or to the first Vertebræ.

Each of the Gills consists of two ranges of Cartilaginous Laminæ, and are joined together for two-thirds of their inner edge. The Laminæ issue like rays, and have the Branches of the Pulmonary Artery minutely dispersed upon them.

In many Cartilaginous Fishes, as the *Raja*, *Squalus*, &c. there are five Gills on each side. In the *Lamprey* there are seven. In a small Animal, the *Hippocampus*, eight.

In the first set of Cartilaginous Fishes, as the *Skate*, &c. there are, on the inferior surface of the Animal, Holes equal to the number of the Gills, and on the Dorsal side, an opening behind each Eye; but in the other kinds, there is only a single opening externally

nally from the Gills on each side, (an *Apertura Branchialis*), and this is covered by a moveable Gill-flap, (an *Operculum Branchialis*), which can move outwards or inwards at the will of the Animal.

After the water has been received by the Mouth, from this it is sent to the Gills, which expand, by the action of Muscles peculiar to them, in such a manner as to have it freely applied to their surface; in consequence of which, Fishes derive Oxygen from water, as breathing Animals do from the Air in their Lungs. But the water does not return by the Mouth: it is discharged by the Branchial openings, in which case Fishes differ from the former class, in not expiring through the same passage by which they inspire.

OF THE ALIMENTARY CANAL.

THE *Peritoneum* in Fishes is similar to that in Mammalia, but is sometimes of a black colour, though often argentine. In the *Skate* tribe, it is not a shut Sac, as in Mammalia. It communicates by two Holes externally, one at each side of the Anus, by which secreted Liquors seem to escape from the cavity of the Abdomen, but a kind of Valve appears to prevent the surrounding element from entering. The Diaphragm forms in Fishes a distinct partition between the Thorax and Abdomen, but is purely Membranous.

The Alimentary Canal is generally very short in this class of Animals, and seldom makes more than one, two, or three turns. In the *Pipe Fish*, *Lamprey*, *Trunk Fish*, and many others, it extends almost straight from the Mouth to the Anus. In some there is very little distinction into Stomach and Intestines, but internally the difference is generally marked by the structure, by the Pylorus, and by the Valve of the Colon.

In many of the class, the Esophagus is so short and wide, as scarcely to be distinguished from the Stomach; and the Food is frequently found remaining partly in the Esophagus, till that in the Stomach is digested.

In the *Branchiostegi*, there is great difference in the form and structure of the inside of the Esophagus. It is beset with strong Combs or Tufts forming a fine Network, which distinguishes it from the Stomach.

The Stomach of Animals of this class is generally long, and frequently found full of Fishes retaining their natural form, but quite pulpy, digestion being considered to be chiefly effected here by solution.

In the *Squalus* kind, there are numerous large Plicæ in the Stomach, running in a longitudinal, or in a transverse direction, or in both. In the *Mullet*, the Stomach is so rough within, that the Animal is enabled to ruminate, and hence is ranked one of the Spurious Ruminants.

The Intestines, in this class, vary still more than in the former, particularly with respect to the distinction between small and great. Sometimes the diameter of the two is the same, though differing in structure. Sometimes the difference in size is inverted, the upper being

being larger than the under portion of the Canal. Sometimes the Coats of the upper are thicker than those of the under part of the Gut.

In the greater number of Cartilaginous Fishes, as the *Raja* and *Squalus*, where the Canal is remarkably short, but is considerably dilated near the Stomach, the surface of the Gut internally is extended by longitudinal Spiral Valves.

In the *Sturgeon*, the inner side of the Intestine forms a curious laminated Plexus and Fossulæ, which are covered with small Glands. In the *Frog-fish* and *Sea-Wolf*, there is a lozenged appearance. In the *Turbot*, the inner side of the Gut has many fringed Laminæ.

In the *Skate* tribe, there is a kind of Cæum, or Appendix Vermiformis, between the small and great Intestines, but none in Fishes with Osseous Skeletons. In these the Gut is surrounded, at its origin, by small blind Appendices, or Intestinula Cæa, which open into it. They are sometimes long and slender, at other times thick and short, or simple, or ramified; the number varying from 1 to 150 and upwards, and even in different Species of the same Genus.

They are found in all the Osseous Fishes, with few exceptions, as the *Pike*, and secrete a fluid useful in digestion.

In Cartilaginous Fishes, as the *Skate*, in place of these, there is a Glandular Body, which has been compared to the Pancreas of warm-blooded Animals.

The Intestines, in Fishes strictly so called, terminate in a common Cloaca, situated near the middle of the inferior part of the Belly, or before the Anal Fin.

In

In the *Raja*, they terminate near the middle of the under and posterior part of the Body; and in this, as well as in the *Squalus*, it gives passage to the Fæces, Semen, and Ova.

OF THE AIR-BAG.

THE *Air-bag* is situated between the Mesentery and the Spine, to which it adheres, in some through its whole length, in others only partially.

It is very variable in form in different Genera and Species. It is commonly simple, as in the *Salmon* and *Cod*; double, as in the *Cyprins*; in others long, round, or oval.

It consists of two Membranes, the outer of which is regarded by some as Muscular, and is covered partially by the Peritoneum. In the *Cod*, and also in the *Sea Perch*, a pair of Muscles run along the sides of the Air-bag, and these are assisted in their action by the great Lateral Muscles upon the Bodies of Fishes.

It contains a quantity of air, differing in its nature in different Fishes. Nitrogen, with a small portion of Carbonic Acid Gas, has been found in the *Carp*, Hydrogen in the *Tench*, and Oxygen in the *Shark*.

By the contraction of the Air-bag, whether by the action of its own Coats, or of the Lateral Muscles of the

the Body, the contained Air is considered to be condensed, by which the Animal can sink; or, by a relaxation of these parts, the Bag can be dilated, so as to allow the Fish to rise again at pleasure. The Cavity of the Air-bag is commonly uniform, but sometimes divided by Septa, as in the *Silurus*, or Cellular, as in the *Porcupine Fish*. Its sides also vary much in thickness and strength in different Fishes.

Upon the inner side of this Sac, in the different Species of *Gadus*, as *Cod*, *Haddock*, &c. a Gland is situated, which has a lobulated structure; and in the *Eel*, there are two, from which the contained Air is supposed to be secreted. In the *Sea Perch*, there is also a Gland, but, besides this, there are two others on the outside of the Bag, from which numerous Vessels containing Air arise, and unite into a Trunk that opens into the Sac. In other Fishes, no similar Organs are found, but Vessels are observed on the inside of the Sac, which seem to secrete Air to answer the same purpose.

The Air-bag generally communicates by one, and sometimes by more Ducts of various lengths, with the middle part of the Esophagus, or of the Stomach, though more frequently with the former. Sometimes, as in the *Herring*, it ends in the bottom of the Stomach. In some, as the *Sturgeon*, it communicates with the Stomach without the intervention of a Tube; and here, as also in the *Salmon*, there is a Sphincter Muscle, which may act as a Valve. Where a Sphincter is not found, the Muscular Fibres of the Organ in which the Tube

Tube terminates, are considered as answering the same purpose.

In the *Cod* and *Haddock* there are no openings, but they have two long blind Processes, which terminate at the Fauces.

The presence or absence of the Air-bag in Fishes is extremely variable. It exists in some Species of the same Genus, and not in others, and is considered, therefore, as an Accessory Organ of Motion, the absence of which can be supplied by other means. It is more generally present, and largest, in those of a long and roundish form, as the *Cod*, *Salmon*, &c. and these swim with the greatest velocity; but when the Bag is punctured, or otherwise ruptured, the Animal immediately sinks to the bottom. Dead Fishes, on the other hand, where the Bag remains entire, float on the surface of the water, an additional quantity of Air being probably generated by putrefaction, and their Bodies thereby rendered lighter.

The Air-bag is for the most part wanting in flat Fishes, as the *Skate*, *Sole*, &c. their broad surface and side Fins compensating for the want of this Organ; but these Animals can only swim at the bottom of the water.

It is wanting, also, in the *Shark* tribe, but the want is supplied by the great strength of the Tail. The *Lamprey* has none, and though many of the *Eel* tribe have a small one, these Animals are kept down by the weight of the Tail.

OF

OF THE LIVER, &c.

THE *Liver*, in many of the Animals of this class, is remarkably large in proportion. It lies chiefly in the left side, and in some, as the *Skate* and *Cod*, contains a great quantity of Oil, though these Animals, as well as Fishes in general, are destitute of Fat.

The Colour is a whitish yellow, or rather grey.

It varies in the number of its Lobes, often in different Species of the same Genus, and is extremely tender in its consistence. There is frequently, as in the *Lamprey*, only one Lobe; sometimes two, as in the *Sturgeon*; or two or three, as in the *Cod*, and here they are of great length. The *Skate* has three, and these extend to near the posterior extremity of the Abdomen.

The situation of the *Gall-Bladder* is more variable in Fishes than in the Animals of the former classes. In some, it adheres to the surface of the Liver; in others, as the *Skate* kind, a great part of it is concealed in the substance of this Organ. In some, as the *Cod*, it is at a distance from it. It is wanting in several Fishes, as the *Lamprey*, the *Lump*, and certain Species of *Perch*. In some it is placed horizontally, in others obliquely, and in some it has a transverse direction.

The *Biliary Ducts*, in Fishes, as in Fowls, open separately into the Intestine, and here also there are distinct Hepato-Cystic Ducts. These go commonly in succes-

sion

sion into some part of the Gall-Bladder or its Ducts, or into both at the same time. The Hepato-Cystic Ducts are commonly short, which facilitates the motion of the Bile. In the *Turbot*, *Cat-fish*, &c. these Ducts are numerous, and go into the Gall-Bladder. In the *Eel*, *Sole*, *Perch*, and many others, they go in succession into the Cystic Duct. In the *Skate*, *Salmon*, &c. they go partly to the Gall-Bladder, and partly to the Cystic Duct.

Pancreas.—In Osseous Fishes, there is no other Pancreas than the Intestinula Cæca formerly described. They send two large Canals into the Intestines, and when these are wanting, as is the case in the *Carp*, &c. the walls of the Intestines discharge abundance of Humour from Glands placed upon their inner surface.

In Cartilaginous Fishes, as the *Skate*, there is a Pancreas resembling that in the former classes of Animals. It is of an irregular form, and is placed at the origin of the Intestines. The substance appears compact, but Gelatinous, when cut. In the *Sturgeon*, the Pancreas forms a sort of medium between that in the *Skate*, and the Intestinula Cæca in the *Osseous* Fishes; it opens into the Intestine by three large Orifices, and has internally a singular reticulated appearance.

Spleen.—The Spleen gradually diminishes in proportional size from Mammalia to Fishes. In the *Raja* and *Squalus*, it is placed on the Stomach; in some it is fixed to the first part of the Intestines; in others, between the Stomach and Liver; in a great number, it is under the Air-bag, and above the other Bowels: In all, it is fixed in its place by the Peritoneum. It varies considerably

derably in its form here, as well as in the Animals of the former class. In the *Raja*, *Squalus*, and *Sturgeon*, it is almost triangular; in others, angular, spherical, &c. In some it is remarkable for its length.

OF THE URINARY ORGANS.

FISHES in general have Kidneys; some have a Bladder of Urine, and others want it. The *Kidneys* are large in proportion, but smaller in the *Raja* and *Squalus* than in other Fishes. In the greater number they are long, narrow, and united apparently into one mass. They adhere to the Spine from the posterior part of the Abdomen to near the Orbits, and have the Peritoneum extended over their under surface.

They are uniform in their substance, soft, and of a reddish brown colour.

Renal Glands are wanting in this class.

The *Ureters* begin by numerous roots, and run along the under surface of the Kidneys. They terminate either in a Vesica Urinaria or a Cloaca; or unite together to form a dilatation, which supplies the place of a Bladder of Urine.

The *Urinary Bladder* is very variable here. It is wanting in the *Raja* and *Squalus*; in these the Ureters end in a Cloaca, as in Birds. In other Cartilaginous Fishes, it is present, but is proportionally small, and is thin

thin in its Coats. It is remarkable in receiving the Ureters at its Fundus or anterior part.

The *Urethra* is short, and commonly opens behind the Anus by an orifice, which also gives issue to the Semen in the Male, and Ova in the Female. In most Osseous Fishes, the Ureters, near their termination, form a large dilatation, which opens externally by an orifice generally behind the Anus, which also gives passage to the sexual evacuations.

OF THE MALE ORGANS OF GENERATION.

THE *Testes*, in Fishes, on account of a difference of structure, are divided into two kinds, viz. 1. Those of the *Raja* and *Squalus* in the Cartilaginous Fishes, and, 2. Those of the other part of the Cartilaginous Fishes, and all the Osseous kind.

The Testes of the first kind are analogous to those in the *Frog*. They are flat and of great extent, are situated between the Spine and the Stomach and Intestines. Each is divided into a large and small portion. The first is a mass of spherical Glandular Bodies, which, in a common-sized *Skate*, are nearly as large as Peas, and press against each other, being intimately connected

nected together, and covered by a delicate Membrane. The other portion is formed of a uniform Glandular Substance, something like the soft Row or Milt of Osseous Fishes.

The *Epididymis*, here, is also of great size, and formed of a large Canal making innumerable convolutions. From this goes out a Vas Deferens, which runs along the edge of the corresponding Kidney in a zig-zag manner; increasing in size till it terminates in a Vesicula Seminalis near the Anus.

At the outer side of the Vesicula Seminalis, is a Bag filled with a greenish matter, which is discharged into the Sac for receiving the Semen. By some Authors, this Bag is considered as a Vesicula Seminalis; by DR MONRO, as supplying the place of a Prostate Gland. In some other Cartilaginous Fishes, as the *Torpedo*, the Vas Deferens and the Vesicula open into the Cloaca by means of a Papilla, the Penis being absent here, as well as in all the other Animals of the Class.

In the other kind, or *Roe Fishes*, the Testes hold nearly the same situation as in the *Raja* and *Squalus*, and are large Glandulo-membranous Sacs; in some Cylindrical, in others Conical, &c. The size increases greatly at the spawning season; at other times, they can scarcely be distinguished from the *Roe*. They are filled with a white Milky-like matter, the Semen, which appears to be deposited in cells.

Through the middle of each Testicle passes a Vas Deferens, which unites with its fellow at the posterior part of the Abdomen, and opens by an orifice, com-

monly situated behind the Anus. In some, as the *Carp*, the Vas Deferens opens into a sort of Vesicula Seminalis, which terminates in the Cloaca.

OF THE FEMALE ORGANS OF GENERATION.

IN a part of the Cartilaginous Fishes, and in Osseous Fishes, excepting those of the Viviparous kind, the Ovaria and Oviducts appear to be blended together, and the Ovaria seem to terminate directly upon the outer surface of the Body; but in another part of the Cartilaginous and of the Osseous Fishes, the Ovaria and Oviducts are distinct from each other.

In the *Raja* and *Squalus*, there are two Ovaria and two Oviducts. The anterior extremities of the Oviducts are situated behind the Diaphragm, and united together, and also to the Spine. In the *Skate*, the Oviducts have one common opening at their origin. Each Duct passes backward and outward, and is of a cylindrical form, but of small diameter. Internally, it has longitudinal Plicæ and Glandular Papillæ, and leads to a large and thick Glandular substance, which is considered as secreting the Glaire of the Egg. It afterwards dilates into a large Sac, which is the Uterus, where the Egg receives its Shell. The Shell has a horny

horny consistence and quadrangular form, with curved Spinous corners, and is sometimes known by the name of *Sea-mouse*, though this term applies more properly to a small Animal, the *Aphrodita*. In the *Shark*, this substance has a plaited appearance. The Uterus terminates at the sides of the Cloaca, while the Alimentary Canal ends at its under part.

The Ovaria are situated at the sides of the Spine, and contain Ova of different sizes; the smallest are of a white, and the largest of a yellow colour They pass by degrees into the Oviducts, getting first the Albumen, and then the Coraceous Shell. The Ova bear a strong resemblance to the Yolks in Birds; but Fishes of this kind hatch the Eggs in the Abdomen, and afterwards bring forth the young.

While the Fœtal *Skate* lies in the Shell, upon opening this substance when perfectly recent, the Animal can be seen moving in the fluid in which it swims. There is likewise observed at this period, a short Tube, which conveys the Yolk to the Intestines, as in Birds.

In the *Shark*, from 20 to 50 Fœtuses have been found, laid regularly by the sides of each other, in the Cavity of the Uterus.

Oviparous Bony Fishes.—The Female Organs of Generation, in these, consist of two Bags containing the Ova, and termed the *Roe*. The Ova are small and extremely numerous, upwards of 60,000 having been counted in a *Perch* weighing little more than a pound; and in some other Fishes, more than 200,000 have been found. The Bag containing them is situated, as the Testes are in the Male, at the sides of the Spine,

and are two delicate Membranes, which extend in the Abdomen as far as the Anus; occupying, near spawning-time, a great part of the Belly. The Ova are generally disposed in transverse layers, and connected by Blood-vessels. The common exit is behind the Anus, without the intervention of an Oviduct. In many Fishes, the Ova or Spawn of the Female is observed to be first discharged, after which the Semen is ejected from the Male, and scattered over the Spawn; the fecundation of these Animals being external.

PART

PART V.

OF MOLLUSCA.

The Mollusca, like other Invertebral Animals, are destitute of a real Skeleton; but many have distinct *Jaws*, which are fixed in the Flesh, there being no Head for articulation. In the *Cuttle-Fish*, there are two horny Jaws, like the Bill of a *Parrot*, situated in the centre of the fore part of the Body, and serving for the trituration of the Shell-fish which the Animal devours. Surrounding the Jaws are the *Tentacula*, or Large Arms, which, by means of numerous cups placed upon them, enable the Animal to fix itself to surrounding objects. Some of the individuals of this class, as the *Snail*, have but one Upper Jaw; others have two Lateral Jaws. The *Tritonia* has two Jaws, which act like the blades of Scissars; but many have none. In some, as the *Whelk*, &c. a Proboscis supplies the place of Jaws. In the back of the *Cuttle-Fish*, there is a kind of Bone composed of Lamellæ. In other Species, its appearance is different; but it is generally elastic and transparent. The *Sepia Octopus* wants it.

The *Epidermis*, in this class of Animals, varies in thickness in different individuals. In Testaceous Mol-

lusca, it covers the Shell on both sides, and may be readily separated from it by means of diluted acids. Most of this class produce a viscid liquor, which lubricates the Skin. In the Mollusca Testacea, the Shell is formed in a peculiar viscous substance, the *Sacculus Calcareus* of SWAMMERDAM.

The *Muscles* agree, in many particulars, with those of the Animals of the former class. In the *Mollusca Cephalopoda*, the Sac which composes the Body is formed of a Muscular substance, divided into Layers, fitted for moulding the Animal into various forms. Two strong Muscles arise from each side of the Sac internally, and are fixed to the Head. The Tentacula round the Mouth have Muscles, some for acting directly upon them, others proper to the Suckers placed upon these bodies. The first set enable the Animal to move the Tentacula in every direction, the second contract the cups from a flat to a hollow surface; and by forming a kind of vacuum within them, enable the Animal to fix itself firmly to surrounding objects.

The Muscles of locomotion, in the *Gasteropoda*, reside in the under part of their Body, which serves them at once as a sort of belly and foot. It consists of fleshy fibres running variously, by which it can contract a part or the whole of the Body at the same time, as may be readily perceived in the *Slug* or *common Snail*. In the *Gasteropoda*, as the *Snail* or *Limpet*, there are additional Muscles arising from the inner surface, or from the edge of the Shell, by which the Animal can protrude from, or retire into its covering. The *Acephala*, as the *Oyster*, *Muscle*, &c. have a covering principally composed

posed of a Membrano-muscular substance, termed *Cloak*. This, in the greater part of the Species, is covered by Shells of various forms, and furnished with complete hinges. These hinges are connected by Ligaments placed in different parts of the Shell according to the kind, and of such an elastic nature as to have a constant tendency to open the Shell. The Cloak varies much in the different Genera. Most frequently it is open before, as in the *Oyster*, *Musele*, &c. Sometimes it is perforated at both extremities, as in the *Razor-shell*, &c. The Cloak of the *Oyster* is formed, like the Shell, of two pieces fixed next the hinge, and has a semi-transparent appearance. The pieces are perforated by the Muscle which closes the Shell. The opening which receives the nourishment, and that for discharging the Fæces, are formed by the Cloak, and these are sometimes prolonged into a Proboscis. In the *Oyster* and *Muscle*, there is only one of these openings, which is the Anus; the nourishment entering by a slit in the Cloak.

The Valves of the Shells are closed by one or two Muscles, according to the shape of the part. In the *Oyster*, and others of a similar form, there is only a single Muscle, but of great strength. It is situated near the centre of the Shell, and behind the Liver. It is fixed firmly to both portions of the Shell, and shuts them with great force; the elastic Ligament at the hinge acts as an antagonist, by opening the Shell.

In the *Muscle*, *Cockle*, *Razor-shell*, &c. there are two Muscles for shutting the Shell, and they are placed near the hinge.

Many Acephalous Mollusca have a locomotive power,

in consequence of a Muscular Appendix or *Foot*, having on each side a set of Fibres like Silk. This Body they can protrude or retract, so as to fix themselves to solid substances, or drag themselves along the sand. This substance is termed the *Beard*, and is exemplified in the *Fresh-water Muscle*, where it is situated under and near the fore part of the Shell. By means of the Beard, the Animal has sometimes been observed to move to the distance of some yards in a few hours.

The *Oyster*, *Scallop*, and several others with unequal Shells, have no Foot, and are therefore deprived of locomotion. In the *Razor-shell*, the Foot is of such a nature as to enable the Animal to come to the surface, or bury itself in the sand, with great rapidity. In the common *Cockle*, the Foot is shaped like a Tongue, and is moved by several Muscles on each side, being employed both in spinning and crawling. The former of these functions is performed by seizing, with its point, the Gluten which is furnished by a Gland situated at its base. It draws this out into threads, and, while still soft, it attaches them to the rock, &c. to which the Animal is to be fixed.

The *Nervous System* exists in most of the Animals of this class, and consists of a Brain placed upon the Esophagus, and of Nerves. In the *Sepia*, the Brain is contained in a Cartilaginous Covering belonging to the Head, and has connected with it a kind of Medullary Collar, inclosed in a semicircular Canal, which gives passage to the Esophagus. From the Collar, Nerves are sent off to the different parts of the Body. Some of considerable size go to the Tentacula; two Optic Nerves perforate

perforate the Sclerotis, and swell out into large Ganglia, from which Fibrillæ go through the Choroides to form the Retina. A pair of Nerves belong to the Muscles of the Sac, and another to the Organ of Hearing. A pair near the Heart forms a Plexus, which supplies the different Viscera. In the *Sepia Loligo*, the Brain consists of a small round Body, behind which are two little Lobes analogous to the Cerebellum. These send off a mere Filament in place of a Spinal Marrow. On each side of the Brain is a large mass, which sends off the Optic Nerve. In the *Snail* and *Slug*, the Brain is situated, in the former over, and in the latter behind, the Esophagus, and sends off a Process on each side of it, both uniting below into a large Ganglion, from which and the Brain, Nerves are sent to the different parts of the Body.

Eye.—The *Sepia* alone of this class of Animals possesses true Eyes. Here we observe their great size, and the Skin covering them loosely as in Serpents; a transparent Membrane underneath, which supplies the place of a Cornea, and to which the Lens is closely connected without the intervention of an Aqueous Humour; the Iris intimately connected to the Sclerotica, and a Semilunar Process projecting at the edge of the Pupil; the Ciliary Processes large, and forming a Zone about the Lens; between the Sclerotic and Choroid Coats, Glandular Bodies and the Ganglion of the Optic Nerve, which separate these two Coats from each other; the inner surface of the Choroides of a deep purple colour, and only two Muscles belonging to the Ball of the Eye.

The parts considered as the Eye of Mollusca with Tentacula, or Horns, as the *Snail* and *Slug*, are placed

ced upon the outer extremities of the Horns, though it is not yet fully ascertained whether these parts are real organs of vision. The Muscles which affect them arise from the edges of the Foot of the Animal, and extend as far as the Eyes. By these the Tentacula are drawn to the Head, something after the manner of an inverted Finger of a Glove. By a set of Circular Fibres contracting in succession, the Eye is restored to its former external appearance.

The Organ of Hearing in the *Cuttle-Fish* is a simple Bag, concealed in the Annular Cartilage at the base of the great Tentacula. In the *Sepia Officinalis*, the Sac has a Bone suspended in the Fluid which it contains. In the *Sepia Octopus*, there is only a chalky substance.

The Organ of Smell is supposed to belong to many of the Mollusca, but the situation is unknown.

The Lips, in the Animals of this class, are in some short or real Lips; in others, elongated into a Tube or Proboscis. In the *Cephalopoda*, they are in form of a fleshy circle; in the *Gasteropoda*, they are merely a longitudinal Slit. The Proboscis in many Mollusca, as the *Whelk*, &c. is a fleshy Tube for seizing the Food at a distance. It forms a kind of double cylinder, which can move in every direction, and retract within the Body.

The Tongue varies much in length in some of this class, as the *Limpet*, where it is almost as long as the Body; but in such cases there is no Proboscis. In the *Cephalopoda* and *Gasteropoda*, the Tongue is covered with Spines directed backwards. The *Sepia*, *Snails*, and greater part of the *Gasteropoda*, have a Cartilaginous

nous Tongue. In the *Acephala*, a proper Tongue is not very evident.

The Salivary Glands, in *Cephalopoda* and *Gasteropoda*, are considerable. In the former there are two pairs, each having a Duct, which unites with its fellow, and opens into the Mouth near the Tongue; the latter have commonly but one pair, which lies near the Mouth.

Circulating System.—In the *Cephalopoda*, the Circulating Organs are more complicated than in other Animals. In the *Cuttle-Fish*, there are three Hearts, two Pulmonary, and one Aortic. Each of the Pulmonary Hearts consists of an Auricle and Ventricle. The Aortic Heart has only a Ventricle. There are two Pulmonary Arteries, one on each Gill, and the same number of corresponding Veins; an anterior and a posterior Aorta; and an anterior and two posterior Venæ Cavæ. At the openings of the Veins into the Hearts, of the Auricles into the Ventricles, and of these into the Arteries, Valves are placed to prevent the retrograde direction of the Blood. The Ventricles have also Columnæ Carneæ, as in the former classes of Animals.

The anterior Cava separates behind into two parts, each of which receives a posterior Cava, and terminates in an Auricle. Where the Veins meet at the Pulmonary Hearts, there is an intricate net-work of Columnæ Carneæ and Foveæ. The Auricle opens into the Ventricle, which is placed at the root of a corresponding Gill. From the Ventricle the Branchial Artery is sent out, which runs along one side of the Gill, while the

Vein

Vein returns by the other. The Branchial Vein terminates in the Aortic Ventricle, from the opposite ends of which the Aortæ go out, sending Branches to the different parts of the Body, from the extremities of which the Veins return by the Venæ Cavæ.

The other Mollusca have a simple Heart, consisting of an Auricle and a Ventricle. The *Gasteropoda*, as the *Slug*, *Snail*, *Limpet*, &c. have each also one Auricle and one Ventricle.

The Veins of the Body, upon approaching the Lung, change into a Pulmonary Artery, in the manner the Vena Portæ Abdominalis changes into the Porta Hepatica; the Pulmonary Veins go to the Auricle, and this to the Ventricle, which sends, by an Aorta, Branches to the different parts of the Body. The Pulmonary System here is situated in the vicinity of the Rectum, by which the Vessels receive more readily the Veins of the Intestines.

The Acephalous Mollusca, as the *Muscle*, and different *Conchæ Bivalves Equivalves*, have the Heart near the Rectum. The Auricle receives the Blood from the Branchiæ, and sends it to the Ventricle, whence it is transmitted to the Body.

Organs of Respiration.—These consist of Branchiæ, which are either concealed or exposed. The *Cephalopoda* and *Acephala* have them shut; the *Gasteropoda* have them in different situations. In the *Cuttle-Fish*, the Lungs form two Conical Bodies, lying on each side of the Sheath, which incloses the Viscera of the Abdomen. The *Slug* and *Snail*, among the *Gasteropoda*, have

have a Cavity in the Neck, which supplies the place of a Lung, and has the Pulmonary Vessels dispersed upon its surface. The Lung, in these Animals, terminates by a small orifice on the surface of the Body, which can be opened or shut at pleasure, and the Lung dilating or contracting, can admit or expel the air. In the rest of the *Gasteropoda*, the orifice varies considerably in its situation, being in the back in some, in the breast in others. Some of the Acephalous Mollusca, as the *Oyster*, have their Lungs in form of Gills, which represent leaves, each with a double Lamina, and a double Series of Vessels.

Alimentary Canal.—The Alimentary Canal, in Mollusca, consists, as in more perfect Animals, of an Esophagus, Stomach, and Intestines, but the beginning and termination of the Canal varies considerably in situation in different individuals. In the *Sepia Octopus* of the *Mollusca Cephalopoda*, the Esophagus, having passed the Cartilaginous Ring of the Neck, dilates into first, second, and third Stomachs, which somewhat resemble those of Granivorous Birds. In the *Sepiæ Officinalis* and *Loligo*, there is only a single Stomach or Gizzard. In the *Gasteropoda* in general, the Canal is in form of a Funnel; the most simple is in the *Slug* and *Snail*. The Stomach, in these, is of considerable size, and the Intestines make a couple of turns in their course through the Body. In many of the Mollusca, particularly among the *Acephala*, the Esophagus expands into a Crop, which is covered internally by small Teeth. The *Bulla Lignaria* contains three Teeth of such

such strength, that the Animal masticates other Testacea, upon which it lives. The Anus, in the Mollusca, varies considerably in situation among the different Genera or Species. In the *Cuttle-Fish*, it is at the fore part of the Neck; in the *Slug* and *Snail*, close to the Air-hole; in the *Limpet*, it is upon the top of the Head; and in the *Acephala* in general, opposed to the Mouth.

The *Liver*, in the different Mollusca, is commonly large in proportion; it has no Vena Portæ; it receives its Blood from the Aorta, and returns it by Veins to the Cava. In the *Cephalopoda*, the Liver is a brown mass, situated near the Head, and extending into the Abdomen. In the *Sepia Loligo*, the Bag which produces the ink is situated on the Liver, and sends out a Duct, which terminates near the end of the Rectum. In the *Sepia Officinalis*, the Ink-bag is situated between the Lobes of the Liver, and in the *Sepia Octopus*, at a distance from them. In these Animals, according to CUVIER, the Liver sends Bile of an orange colour, by two Ducts, into the Gizzard. The contents of the Ink-bag are supposed to be discharged by the action of the large Muscular Sheath of the Body of the Animal, and serve to render the surrounding element bitter, when the Creature is in danger of being attacked by an enemy. The *Gasteropoda* have a large Liver, divided into Lobes, which send out a number of Ducts that surround the Alimentary Canal, and terminate in the Intestines. In the *Slug*, the transparent Blood-vessels form a border, which is conspicuous on the dark-coloured Liver. In many of the *Snail* kind, the Liver, with

with the Organs of Generation, occupies the upper turns of the Shell. In the *Acephalous Mollusca*, particularly among the *Bivalves*, as the *Muscle* and *Oyster*, the Liver surrounds the Stomach, and discharges the Bile into it by many openings.

Organs of Generation.—There are here four different combinations found; 1. Separate Sexes with copulation, as in the *Whelk*, and many others among the *Gasteropoda*; 2. Separate Sexes without copulation, as in the *Cuttle-Fish*, and other *Cephalopoda*; 3. The Sexes united with reciprocal copulation, as in the *Slug*, and the greater part of the other *Gasteropoda*; 4. The Sexes united, and each individual fecundating itself, or forming a complete Hermaphrodite, as in the *Oyster* and other *Acephala*.

In the *Sepia Loligo*, the Testicle is a large white Body, filling the bottom of the Abdominal Sac, and inclosed in a Membranous Capsule, to which it adheres at one part by Vessels. It is composed of Seminal Tubes, which occupy the greater part of its substance. The Testicle has connected with it an Epididymis formed of innumerable convolutions, as in the Human Body. There is here, also, a substance somewhat analogous to a Prostate Gland, and a fleshy Organ, hollow within, and perforated at the point, which is considered as the Penis. This receives the Semen from the parts mentioned above, and projects in the Neck at the side of the left Branchia. The Semen, Ink, and Excrementitious Matter, pass through an Infundibulum placed under the Neck. In the Female, the Ova occupy the same place as the Testicle in the Male, and are covered

covered also by a Capsule, and connected at one part by Vessels. One or two Oviducts end at the Anus, or at the sides of the Branchiæ, in the same place as the Penis does in the Male. This, as well as the other Species, has two large Glands, which are supposed to furnish a Gelatinous fluid, to surround the Ova.

In the *Gasteropodous* Hermaphrodites, there is one set, as the *Snail*, and several others, where the Organs of the Sexes have a common outlet, and another, as the *Aplysia*, where they have a separate exit. The first set have a Testicle, a Vas Deferens, a Penis, and a Vesicle with a long Neck. The Testicle is a long white granulated Body, which sends out the Vas Deferens that terminates in the Penis, and this in a fleshy Sac, which is the common Cavity of Generation. The Ovarium is composed of a cluster of Ova, situated between the Liver and Intestines. From the Ovarium an Oviduct goes out, which, about the season of sexual intercourse, makes zig-zag turns, and is so connected to the Testicle, as to appear to receive liquor from it. It terminates in the common Cavity of Generation.

In time of copulation, the *Snail* tribe turn out the common Cavity, which then presents the three openings of the Penis, Oviduct, and Vesicle. The Penis penetrates the Oviduct of the other individual. The Eggs are observed to be produced a few days afterwards. The same circumstances, in general, take place among the other individuals.

Of the *Gasteropoda* with Sexes separate, the Male of the *Buccinum Undatum* is observed to have a Testicle, which, with the Liver, fills half of the deepest part of the

the Shell. The Vas Deferens forms numerous turns, and goes to the Penis, which is of great size. It adheres to the right side of the Neck, and makes a fold in the Cavity of the Lungs. In the Female, the Oviduct is a great Canal at the right side of the Lungs, placed between the Body and Rectum.

The *Acephala* are found to be all Hermaphrodite. They fecundate themselves without copulation. An Ovarium is placed in both sides of the Body, directly under the Skin. At a certain period a white liquor appears, which is considered as Semen. After the Ova are impregnated, they are situated between the Branchiæ. In the Ovo-viviparous, as the *Muscle*, the young can be observed by the naked eye, and, if viewed with a Glass, can be seen opening and shutting the Shell.

PART VI.

OF CRUSTACEA.

THE Body of the Animals of this class has a hard external covering, frequently consisting of several scaly portions; and they have often a considerable number of articulated members.

They have several pairs of Organs supplying the place of *Jaws*, which move only in a lateral direction, the set on one side overlapping that on the other. They have one or two pairs of articulated moveable Bodies, termed *Antennæ*, or Horns, placed on the Head, and two or three pairs of *Palpi*, or Feelers, articulated with the Jaws, for examining their nourishment.

An *Epidermis* exists in this, as in other Invertebral Animals. The Shell holds the place of the *Corpus Mucosum*, but it is without organization. Under the Shell is a transparent Pellicle, instead of a *Cutis*.

Muscles.—Those of the *Lobster* and *Crab* have a considerable analogy to some of the Muscles of red-blood-

ed

ed Animals, but are confined to the parts moving the Tail, the Legs, and the False Feet.

The *Tail* is a strong moveable substance, employed particularly in swimming and leaping, and has powerful Muscles for moving it in various directions.

The *Feet* vary in number and form in the different Genera. In the Genus *Cancer*, as an example, there are commonly five Feet on each side, with six joints to each Foot. The anterior is the largest, and forms the *Pincer*, or Claw. The first of the pieces of the anterior Foot, is the *Coxa*, which is connected to the Thorax; the second the *Femur*, which is nearly of a square form, and moves as a hinge on the Coxa; the third is the *Tibia*, which, at the under extremity, becomes broad and Spinous; the fourth is connected to the Tibia; the fifth is the *Pincer*, strictly so called, which is the largest of the whole, and has opposed to it the sixth, which forms a moveable *Pollex* or Thumb. The other Feet are like the *Pincer*, but differ in this, that the two last pieces are nearly of equal size. The two Posterior Feet terminate each in a single Claw.

Each articulation of the Feet has two Muscles, an Extensor and a Flexor, the strength varying according to the force required.

Nervous System.—This varies according to the form and nature of the Animal. In the *Lobster*, there is a Nervous Cord, which has a knotted appearance, and extends from one end of the Body to the other. The short-tailed *Cancer*, or *Crab*, has a Medullary Circle in the middle of the Abdomen, from which the nerves of the Body go off like Radii. In the *Cray Fish*, the

Brain is divided above into four Lobes, from which a pair of Optic Nerves are sent off. Four Nerves pass to the four Antennæ and adjacent parts. From the posterior part of the Brain Nerves go off, which form a Collar round the Esophagus. The different Nerves form Ganglia, which supply more particularly the several Muscles.

In the *Lobster* kind in general, the *Eye* is placed on a moveable Tubercle, and is somewhat conical. When magnified, it presents different Facets, which are hard and transparent, representing so many Corneæ. Lining these, there is an opaque Pigment, which appears to leave no aperture for the passage of the light. At a little distance from the Corneæ, is a dark-coloured Membrane, considered as the Choroides, which has a production of the Optic Nerve on its posterior, as well as its anterior surface, and therefore forming a sort of double Retina. But how the light can act upon the bottom of the Eye through the opaque lining of the Cornea,—and whether these Animals, from the compound nature of their Eyes, see objects multiplied or single,—are circumstances not understood.

The *Ear*, in the *Lobster*, is a small Sac inclosed in a scaly cylinder. At the base of the Antennæ, the Nerves pass through this cylinder into the Sac, the opposite extremity of which is inclosed by an elastic Membrane analogous to the Membrana Tympani, or the Fenestra Ovalis, and is observed at the bottom of the large Antennæ.

Organ of Smell.—None is found in any of the Crustacea, though many Authors have been of opinion that this

this sense resides in the Antennæ. The Salivary Glands appear also to be wanting in the Animals of this class.

Circulating System.—The *Heart*, in some, as the *Crab*, is placed near the middle of the Thorax, and is of an oval form, but has no Auricle; in others, as the *Shrimp*, it runs from one end of the Body to the other, like a Blood-vessel. The Heart here, as in the *Mollusca Gasteropoda*, receives the Blood from the Branchiæ by one or more Veins, and sends out Arteries, which go to the different parts of the Body. From the extremities of the Arteries, Veins return by a Cava, which divides into Branchial Arteries upon approaching the Gills.

Organs of Respiration.—In the Crustacea, the Organs of Respiration consist of a set of Branchiæ, or Gills, which are proportionally larger than in most of the Animals of the former class. In the *Cancer* tribe, they are placed at the sides of the Thorax, and near the origin of the Feet. In some, as the *Shrimp*, they lie under the Tail between the Fins, floating loosely in the water. The Gills vary in number and form in different Genera and Species; but in all, they are nearly of the same nature with the Gills of Fishes, and have the water constantly applied to them, so as to answer the different purposes of Respiration.

Alimentary Canal.—The Stomach is singular in this class, especially in the *Crab*, *Lobster*, &c. in being formed upon a kind of Osseous Skeleton. Near the Pylorus are five Teeth of unequal size, which, in some of these Animals, as the *Lobster*, are observed to be re-produced annually along with their external covering. The Teeth

are moved by particular Muscles, and possess a true power of mastication.

The *Stomach* is situated in the Thorax above the Mouth, and, from its particular structure, is prevented from contracting and dilating like the Stomach of other Animals. The small Intestine is straight and cylindrical, but, towards its middle, it has a strong Valve and a long Cæcum.

Liver, &c.—The greater part of this class have no proper Liver. The Bile is derived from a collection of Intestinula Cæca, similar to those which supply the place of Pancreas in Osseous Fishes. They are of a yellow colour, and contain a bitter brown fluid, which they discharge into the beginning of the Intestine. These, together with the Stomach, fill almost the whole of the Thorax, the former composing the high-flavoured substance in the *Crab* and *Lobster*.

Shrimps have a Liver of a different nature from that of other *Crustacea*; being a solid Conglomerate Gland, arranged along the two sides of the Intestines, through their whole length.

Organs of Generation.—Here the Testes in the Male, and Ovaria in the Female, are in some united together, and their External Organs are double. In the *Crab*, *Lobster*, &c. the Male has two Penises, and the Female two Vulvæ.

In the Male, the Testes are two Glandular-like Bodies, separate in the *Crab*, but united in the *Lobster*, and here placed under the Heart. From the Testes, two convoluted Vasa Deferentia pass out, which end in a corresponding Penis behind the Fifth Pair of Feet.

Each

Each of the Penises has a horny Sheath, which conducts it to the Vulva of the Female.

Of the Females, the *Lobster* kind has the Ovaria united into one Body. Two short Oviducts go directly to the Vulvæ, which are simple Foramina in the substance of the Corslet or Thorax, at the base of the third pair of Feet.

Crustaceous Females, after producing their Spawn or Ova, collect them at the Filaments of the Fins under the Tail, and carry them there till they open.

PART VII.

OF INSECTS.

Insects, like the other Genera of Invertebral Animals, want an Osseous *Skeleton*; a horny substance, in the greater number of perfect Insects, serves them for Skin and Bone, inclosing the Muscles and Internal Organs, and giving attachment to the different Members.

Some, as the *Locust* and *Beetle*, have Jaws large and distinct, placed in a lateral direction, and moving horizontally; others want them. Some have two *Lips*, the one above, the other below. They have articulated with the Head, Antennæ, and with the Mouth or Jaws, Palpi or Feelers, for examining their nourishment. All the Insects with Jaws have the power of masticating hard Animal and Vegetable substances.

All Insects, which possess Wings, metamorphose, or pass through certain changes, before they arrive at their perfect form. In their first state, after leaving the Egg, they form *Larvæ* or *Caterpillars*. The *Larvæ* differ from complete Insects, chiefly in their Organs of motion. The Rings or Segments of which their Skin consists, are moved towards each other by Muscular

cular Bands situated within the Body. Sometimes they are covered by Bristles or Hooks, which enable them to lay hold more firmly of other substances. Many have Hairs or Spines upon the surface of their Body, which are cast off with the Skin at certain periods, and are afterwards re-produced.

The Bodies of many *Larvæ* have, at their under, and near their fore part, six Feet, each terminating in a hook, by which they can fix themselves, and draw the posterior to the anterior part of their Body. Some have, besides, a number of small Claws, to assist them in their motions. Others crawl by the assistance of hooked Mandibles, and by Tubercles on different parts of their Body.

The Bodies of Insects are divided into Head, Corslet, Pectus, Abdomen, and Members. The Head is joined to the Body, in some, by ball and socket; in others, by plain surfaces; in others, after the manner of a hinge. In some, the connection is entirely Ligamentous, the different motions corresponding with the nature of the Joint. The Corslet or Thorax is situated between the Pectus and Head. The first pair of Feet are joined to this, and it contains the Muscles for moving these and the Head.

The Wings, when present, are fixed to the upper part of the Pectus, and the four posterior Feet to its under part. To the upper part a Horny Process is frequently fixed, termed *Scutellum*, or *Escutcheon*. The Pectus contains the Muscles which move the Wings and four pair of Feet.

Abdomen.—It commonly consists of different Rings.

In

In some, it is directly continued from the Breast; in others, there is an evident contraction between them, and a real Joint connected by Ligaments. Sometimes the Abdomen is terminated by a Sting, by Bristles, Plates, &c.

Members or *Feet*, and *Wings*.—In winged Insects, the number of the Feet is generally six, never less, but frequently more; *Scorpions*, *Spiders*, &c. have eight; *Millipedes* and *Scolopendra*, or *Centipedes*, have them attached to every ring of the Body. The Feet consist of the Coxa or Haunch, the Femur or Thigh, the Tibia or Leg, the Tarsus or Toe. Each of these is inclosed in a horny case, and moves as on a hinge. The Toe consists, in general, of several Joints, the last of which is terminated by one or two hooked Claws.

The Articulations vary according to the mode of life. They are slender in many that burrow in the earth, as in the *Scarabæus*. They are like Fans, and ciliated on the sides in those that swim, as in the *Hydrophilus*, or Diver. They have Viscous Balls, bristly Tufts, &c. in such as walk in smooth and slippery parts, as in the common *Fly*. In Insects that crawl upon Hairs, there are two moveable and opposite Claws, as in *Lice*, &c.

Each of the Joints of the Feet is furnished with an Extensor and a Flexor Muscle, inclosed in the preceding Joint.

The Wings are attached to the lateral parts of the Pectus. The greater number of Insects have four, some only two, some none. In some, they are purely Membranous; others have them covered with Farinaceous Scales

Scales of different colours. In the *Coleoptera*, &c. the Scales of the Wings, and in the *Lepidoptera* and some others, those of the Body, are small Horny Plates, laid over each other like the tiles on a house.

The Muscles that move the Wings are not well ascertained. Some are small and short, and are supposed to extend or to fold them; others are larger, for elevating or depressing them.

Epidermis.—Insects in general, whether in the perfect or imperfect state, possess an Epidermis. In the *Larva*, it is found to be several times shed before the Chrysalis state takes place. It varies in thickness in different Insects. In those living in water, it is commonly of a Mucous nature. Perfect Insects have no Cutis, of course no Papillæ Nervosæ. Their Palpi or Feelers are considered as proper Organs of Touch, by which the Animal examines surrounding objects.

The Corpus Mucosum is placed between the Cuticle and Muscles in the *Larvæ*, and is supposed to give origin to the colour of Insects. In some, as the *Fire-Flies* in America, there is a Gelatinous shining colour, which gives light in the night.

Brain and Nervous System.—The Brain, in Insects, may be considered as the anterior extremity of the Spinal Marrow, slightly enlarged. In the Larvæ of large Insects, the Brain consists of one or more Lobes in a Horny Cavity in the Head.

From these Lobes commonly two Nerves descend, and, embracing the Esophagus, unite into a Cord analogous to the Spinal Marrow. This extends through

the

the Body, forming, in its course, ten or twelve Ganglia, from which, and from the Brain, Nerves go off to the different parts of the Animal.

In perfect Insects, the Brain has generally two Lobes, and is also situated above the Esophagus.

The Nerves and Ganglia, in some Insects, are similar in number, general appearance, and distribution, to those of Larvæ; in others, they vary considerably in all these respects.

Eye.—There are two kinds of Eyes in this tribe of Animals, some small and simple, and termed *Stemmata*, varying from two to eight in number; others are large, appearing like a collection of smaller Eyes, but are only two in number. These are divided, in some Insects, into many hundred hexagonal convex surfaces, which appear like so many different Corneæ or Lenses. The simple Eyes are found in most of the *Aptera*, and in the Larvæ of many winged Insects, but are too small for examination. When the Larvæ change into complete Insects, they change also their simple for compound Eyes. Several Genera of winged Insects and *Aptera*, are observed to have simple besides compound Eyes; many Insects, on the other hand, have no Eyes. The Eyes of Insects have no Eye-lids, are commonly immoveable, and, according to SWAMMERDAM, do not contain the same Humours which are found in the higher classes of Animals.

The appearances of the Eyes of Insects are so different from those in other classes, that experience alone shews them to be Eyes. When they are covered or cut out, the Animal can no longer find its way.

The

The Cornea of compound Eyes is lined with an opaque Mucus, varying in colour in different Insects. Behind this white spots appear, equal to the number of the Facets of the Cornea. On the back part of this a Choroides is found, which appears to receive a real Retina; but further investigation is necessary to shew how the rays of light can reach the bottom of the Eye, so as to enable the Animal to form distinct vision. In the greater number of Insects, the Eyes appear to be destitute of motion.

Ear.—The Organ of Hearing has not been found in any of the individuals of this class, though it is not to be doubted that they enjoy the Sense of Hearing, since, in the Males, means are provided for calling the Females to them, which are heard by the latter, as is observed in the *Crickets*, *Grasshoppers*, *Death-watch*, &c. Neither is there any appearance of an Organ of Smell, though they give proofs of the existence of this Sense.

They discover their Food seemingly by its smell, sometimes even at a considerable distance; and some, as the *Flesh-fly*, frequently deposite their Ova on Plants, as the *Arum Dracuntium* and *Stapelia Hirsuta*, which have the smell of Carrion; though, in such cases, the Maggots commonly perish through want. The part which has been considered, by some late Authors, as supplying the place of the Organ of Smell, is the Stigma, or entry into the Trachea; by others, the Antennæ have been looked upon as answering this purpose. When Insects are deprived of their Antennæ, it has been observed that they are incapable of recognizing their haunts, or their Food, though placed close by them.

Organ

Organ of Taste and Salivation.—The seat of the Organ of Taste in Insects is variable. The Under Lip by some, the posterior pair of Palpi by others, but commonly the long Tube in the *Butterfly*, has been considered as the Tongue. Many of the *Butterflies*, *Bees*, *Ants*, *Common Flies*, and *Spiders*, have a Spiral or Tubular Tongue, or a soft Proboscis, in a horny pointed Tube, by which they suck in their nourishment. No Salivary Glands are observed in the Mouths of Insects, though a fluid similar to Saliva, but varying in colour in different Insects, is observed to come from the Mouths of some of these Animals.

Circulating System.—No real Circulating System has been found in proper Insects, yet many of these Animals, both in the Larvæ and perfect state, have a Membranous Canal along the Back, in which alternate contractions and dilatations are discerned. In the *Caterpillar*, the pulsation begins at the posterior extremity of the Animal, and proceeds from one segment of the Body to another, till it arrives at the Head. This Vessel is therefore considered by some Authors as the Heart, but it is closed at the extremities, and Vessels are seen going from or to it.

Nutrition and Secretion, therefore, are supposed to be effected in a different manner from what takes place in more perfect Animals. CUVIER considers Imbibition to be the mode by which these are performed.

Respiratory Organs.—Respiration is performed by Tracheæ ramified over most of the Body, but chiefly on the Intestines; there are, however, no Cellular Lungs. The Tracheæ are much larger and more numerous

merous in the Larvæ of Insects, than in the perfect state.

In Larvæ, a Trachea runs on each side of the Body, under the Skin, and generally opens externally by nine or ten apertures, termed *Stigmata*. From these the same number of Air-vessels, or Branchiæ, of a silver colour, pass off, to be dispersed through the Body by innumerable Branches, but particularly on the Alimentary Canal, and on the part compared to the Omentum. The above is the most common distribution of the Tracheæ; but in several Aquatic Larvæ, and even perfect Insects, the Air enters by two openings near the Anus, at the end of the Abdomen. *Hymenoptera* and *Diptera* have two principal Tracheæ, with some small ones, at the base of the Abdomen. The *Aranea* have no Tracheæ; their organs of Respiration are confined to a few Vesicles, but which have an aperture at each side of the base of the Abdomen.

The Tracheæ of Insects are described by Authors as being composed of an outer, inner, and middle Membrane, the last of which is formed of Spiral Fibres.

Insects are incapable of forming any Voice; the noise which many of them make is formed chiefly by their Wings.

Alimentary Canal.—The Esophagus is a straight short Tube, reaching from under the Brain to the first Ganglion of the Nerves. The rest of the Canal differs much in appearance in different kinds of Insects, and in different stages of the same Individual. In the Larvæ state, it is of great size, particularly the Stomach, when compared with that of the perfect Insect.

In

In Insects, as in other Animals, the same proportional size is preserved in the Animal and Vegetable eaters, the Canal being always short in the former, and long in the latter. In the *Dragon Fly*, which is a Carnivorous Insect, the Canal is short, and the Stomach Muscular. In the *Locust*, which feeds upon Vegetables, the Canal is long and complicated, the Stomach Membranous, and there is a true Gizzard. In some the Stomach is single, in some double, in others manifold. The greater number of Insects have a single Stomach, which is sometimes Membranous, sometimes Muscular, at other times there is no perceptible dilatation.

The Stomach of the *Bee* is a Membranous Bag, in which the Nectar of the Flowers is converted into Honey, which it afterwards vomits, and deposites in the Hive. In several instances, the Esophagus and Rectum are surrounded by a turn of the Spinal Marrow. The Mesentery is wanting in Insects.

The Stomach, in the Larva, commonly differs from that of the perfect Insect. In the former, it is for the most part of great size; while in the latter, which take litttle nourishment, it is remarkably small. Some Insects, as the *Grasshopper*, *Cricket*, &c. which have a plurality of Stomachs, have the power of throwing the Food to the Mouth to be chewed again, and are therefore sometimes termed Ruminating Insects.

The Anus, in Insects, not only affords a passage for the Fæces, but incloses the extremities of the Parts of Generation.

Liver, &c.—There is no true Liver in Insects, though, both in the Larva and perfect state, there is a set of fine

fine Vessels, or Intestinula Cæca, attached to the Alimentary Canal, which produce a liquor, generally yellow, though sometimes white, which is considered as the Bile. The Ducts terminate commonly near the Stomach, but now and then in a more distant part of the Intestines.

The Spleen is wanting here, but in Larvæ, and in some perfect Insects, particularly in those that spend a considerable part of their time in a torpid state, a large Adipose substance occupies a considerable portion of the Body, and exists in great abundance in the Larvæ of Insects. It has been considered by some as an Omentum, though a real Omentum, such as is found in many Animals, does not exist in this class.

Insects have neither Kidneys, Bladder of Urine, nor Pancreas, their different secretions being performed by loose Vessels, which float in the Abdomen. By means of these, various fluids are secreted, some of which have a fœtid, and others a pleasant smell. The *Bee*, *Wasp*, &c. have two Vesicles situated at the bottom of their Sting, which throw out a very acrid fluid, that the Animal can discharge at pleasure through a perforation in the Sting. In the *Bee*, the Sting is barbed at the point, and commonly remains in the wound it inflicts. The *Scorpion* throws a fluid of a dangerous nature, also, through its sting. Some of the *Spiders* discharge a fluid, which renders their bite dangerous.

Organs of Generation.—The greater number of Insects have the external parts of Generation situated at the posterior part of the Abdomen. In *Spiders*, with a few exceptions, they are placed in the Palpi Maxillares.

res. The Male Organs in general have a Spermatic Vessel something analogous to Testes, two Vesiculæ Seminales, and a Penis inclosed in a Sheath. The Testes and Vesiculæ vary extremely in different Genera, being in some simple, in others complicated, and differently contorted and collected into Fasciculi.

The *Female Organs* are more uniform than the Male. In the whole class they consist of Tubes or Ovaria, containing the Ova. The Tubes unite into two Canals, and these into an Oviduct, which terminates in a common opening, the Vulva. These parts are even seen in the *Chrysalis* a little before the Metamorphosis. All Insects are Oviparous; their Ova change first into *Larvæ*, *Caterpillars*, or *Maggots*. The Maggot changes into the *Chrysalis*, *Pupa*, *Nympha*, or *Aurelia*. This forms the *Imago*, *Fly*, or perfect Insect.

The parts of the future Animal are observed not only in the *Caterpillar*, but also in the *Chrysalis*, though more distinct in the former.

Before the *Caterpillars* change to the *Chrysalis* state, each spins to itself a covering. The Secretory Organ which forms this is found to be the same in Insects in general, and is well exemplified in the *Silk-worm*. It consists of two long tortuous Tubes, which enlarge by degrees, and form a Sac or Reservoir, from which a Duct goes out, and terminates below the Under Lip. In working the Silk, the Animal fixes its Mouth to some point of a solid substance, from which it carries out a Thread as yet glutinous; this, spun to some length, is fastened to another point, from which a second Thread is

is drawn out in a different direction; and so on, till, by successive repetitions, the Animal is completely inclosed.

In the *Silk-worm*, the change from the *Chrysalis* to the *Fly* happens in ten or more days, according to the season. The Copulation of these Animals is exceedingly tedious, the Male beating his Wings upwards of a hundred times before he separates from the Female. The Ova are soon afterwards produced, to the amount of several hundred, through a short Tube from the end of the Abdomen. The *Fly* dies a few days thereafter.

In some Insects, besides Male and Female, there is a third set, termed *Neuter*, not having the distinguishing characters of either sex. They are a kind of Eunuchs, or Infertile Animals, and are peculiar to this class. They are found only in those that form into societies, as *Bees*, *Wasps*, and *Ants*. There are no Hermaphrodites among Insects.

PART VIII.

OF WORMS.

Worms differ from the former class of Animals, in having no Antennæ, and being destitute of Members. In same Worms are hard parts, forming a sort of Jaws or Teeth. Some have Lateral Jaws. The *Lumbrici* have none. The *Aphrodite* has four Teeth and a Proboscis, which it can extend or retract at pleasure. The *Leech* has three semicircular projecting Teeth, of a Cartilaginous nature, with sharp denticulated edges, with which it pierces the Skin. In a large Species of *Nereis*, the entry into the Esophagus has eight Calcareous pieces in place of Jaws and Under Lip.

Worms possess a distinct *Epidermis*, but scarcely any thing that can be called a Cutis. Several, as the *Aphrodite*, *Lumbricus*, &c. are partly or entirely covered with Hairs, or Bristles, or Spines, or Tubercles, &c. which assist them in crawling, being destitute of Feet. Some, as the Intestinal Worms, are covered with a Slime which may exude from the surface of their Skin.

They have two kinds of *Muscles* for performing their different motions, one consisting of four Fasciculi, two above,

above, and two below their Body, which they move according to the direction or situation of the Fibres. These form the principal part of the Body of the Animal. Another set of Muscles are appropriated to the Hairs, Bristles, &c. and consist of short Fibres, some of which are for pushing them outwards, others for drawing them inwards. By these Muscles, and the Spines, &c. on which they act, the Animal is enabled to perform its locomotion.

One set of Worms want these Spines or Bristles, of course move in a different manner from the former. Their progression is accomplished by applying the two extremities of their Body alternately to the surface of the parts on which they move. These consist of *Leeches*, which have the extremities of their Bodies formed into contractile fleshy Disks or Suckers; or some have Anterior Extremities provided with Hooks; the outer parts of their Body being a fleshy Sac, composed of longitudinal and circular Fibres. By fixing one end, and contracting the circular Fibres, the Body can be so elongated, as to allow the other extremity to reach the place intended. The Animal now fixes this extremity, and, by contracting the longitudinal Fibres, draws the other end forwards.

Nervous System.—No Nerves have been discovered in several of the internal Worms, but in the external Worms the Nervous System has been considered as analogous to that of Crustacea and Insects. A Cord generally runs through the whole length of the Animal, and has Ganglia regularly dispersed, from which numerous Nerves proceed to the different parts of the Body. In the *Aphrodita Aculeata*, the Nervous System is similar to that of

the Larvæ of Insects. A Ganglion representing the Brain is situated on the Head, and forms a Collar round the Esophagus, sending Nerves to the rest of the Body. In the *Leech*, the Nervous System is a slender Cord, composed of numerous Ganglia. The first sends a Collar round the Esophagus; the others send Nerves to the different parts of the Body. The *Earth-worm* has also a Ganglion or little Brain about the Esophagus, but no others in the rest of the Body. The *Lumbricus Humanus* has the appearance of a Collar about the Esophagus, a Cord along each side of the Body, and several Ganglia.

Neither Eyes, Ears, nor Nose, have been discovered in Worms, yet they can select the nourishment proper for them.

Circulating System.—Circulating Vessels are perceptible here, with distinct contraction and dilatation, but without any Heart, in some of the Animals of this class; in others, they are wanting or invisible. The Blood, in several Worms, is more or less of a reddish colour, and in some is as deep as in the higher classes of Animals. A great Vessel, in many, runs along the Back, and diminishes towards the Extremities.

The *Leech* has a principal Vessel on each side, which communicates with the opposite one by many transverse Branches; forming a Plexus on the Back, and another on the Belly. These are supposed by Naturalists to serve for Respiration, there being no other evident Organ for this purpose. There is also a Vessel running along the Back, which appears to be an Artery. It gives Branches to the two sides, but whether the two sets of Vessels communicate, is not fully ascertained.

The

The *Earth-worm* also has longitudinal Vessels filled with red blood, in which, as in all other Worms with red blood, there is a distinct pulsation. Their Vascular Skin supplies the place of Branchiæ; but in the other Genera there is a subdivision of the Blood-vessels in the form of a Tuft, which may answer a similar purpose. In some, as the *Aphrodite*, there are little Crests, like those of a Cock, placed above each Tubercle, carrying Spines. In all these Animals, the Branchiæ are provided with Arteries and Veins, as in the higher classes, and here Respiration is considered to be performed by the Vascular System.

In Hydatids there is nothing like a Vascular System.

Intestinal Canal.—The *Lumbricus Terrestris* has but one long Canal, destitute of a Mesentery, divided by several Partitions; the anterior dilatations forming a sort of Stomach.

In the *Leech*, this Canal runs from one end of the Body to another, and is divided into many Cells.

In some Worms, as the *Tænia* and *Fasciola Hepatica*, the Esophagus serves as an Aorta, conveying nourishment to the other parts of the Body.

In the *Tænia Solium*, or common Tape-worm, which is composed of a chain of Quadrangular Joints, there is an Orifice, in one of the margins of each articulation. This has been considered by most Authors as a Mouth, and by a few, as BLOCH, &c. is regarded as a Vagina. It is sometimes in the one Margin, or sometimes in the other, without observing any particular order. From this Orifice a Canal goes off, which runs along the margin of each Joint, and communicates with its fellow at the extremity of each articulation. A Canal is also seen

in some, proceeding from an Orifice in the middle of each Joint, the Canals communicating between the different Joints through the whole length of the Animal. At the posterior extremity of the last Joint, the Vessels are found to be impervious.

The *Ascarides* have a simple Canal, and nearly equal throughout, running in a longitudinal direction. The anterior portion has a slight dilatation, considered as a sort of Stomach. The *Lumbricus Humanus*, or *Ascaris Lumbricoides*, has a simple Canal, extending through the Body, and ending near the posterior extremity of the Animal. In the *Trichuris Hominis*, (a Worm about two inches long, ending in a filiform Tail), the Intestinal Canal extends through the whole length of the Body. The Liver is wanting in all Worms.

Organs of Generation.—Worms, like Mollusca, have three diversities of Sexes; 1. Separate Sexes; 2. Sexes united. 3. Sexes with reciprocal copulation. The *Aphrodite* has Sexes separate. Individuals of this genus are occasionally found full of Eggs in the intervals of the Viscera, but the preparatory Organs are not yet discovered. The *Lumbricus Terrestris* has the Organs at the under part of the Body, between the middle and the anterior extremity; the Ovarium consists of small oval Sacs filled with Ova. There are two openings here with smaller ones, but no male parts are observed, though they closely adhere in copulation.

Hydatids, so frequently found in the Liver and other parts of the Body in Mammalia, have been considered by some as Animals, consisting merely of a Stomach; by others, as a Matrix or Womb, from something like young Hydatids being frequently found adhering

hering to their inner side. Hydatids immersed in warm water, immediately after being obtained from a living Animal, are observed to have a contractile power, but they have no external opening. They are of different sizes and kinds; most commonly there is either one or more Hydatids floating in the same Cyst. Each consists of two Coats, the inner of which is extremely delicate. Neither of them possesses any visible Blood-vessels, though the Sac containing them has abundance of Vessels, Nerves, &c. derived from those of the Organ with which it is connected. Hydatids ought not to be confounded with watery Vesicles, connected occasionally with the Kidney, &c. which ar not inclosed in Cysts, have no small Hydatids adhering to their inner surface, and want contractility. In other Animals, a Hydatid is found, with a Head and Mouth, by which it adheres to the inner surface of the Sac which incloses it.

In the *Leech*, the Sexes are double in each individual, and they have reciprocal copulation. The Male parts consist of two Testes, each formed of a convoluted Duct. A short Vas Deferens, ending in a kind of Penis, is observed at the under side, near the anterior extremity. In the vicinity of this there is a Vagina, which seems to receive the Penis of the other individual.

The *Lumbrici Intestinorum* have distinct Sexes. In the Male, a thread-like Vessel, four or five times the length of the Animal, much convoluted, but easily unravelled, composes the Testes. This forms a Vesicula Seminalis, which is equal to upwards of a third part of the length of the Body, and is sometimes nearly as large as a crow-quill, full of a milky liquor. The Vesicula

ends

ends in a Penis concealed near the posterior extremity of the Animal.

The Female has likewise two long Filiform Spermatic Vessels, also much convoluted, but readily unravelled, forming the Ovaria. These contain Ova like fine powder. They gradually enlarge, and form two Cornua Uteri, which unite into a Vagina. This opens near the middle of the Body. The Vasa Spermatica, in the Female *Lumbrici*, have frequently been mistaken for young Worms.

Ascaris.—The Male Organs of Generation have not been discovered. In the Female, a slender Tube runs spirally about the Intestinal Canal, and terminates near the middle of the Body. Globules have been found in it, considered as the Ova.

In the *Trichuris*, the Organs of Generation are somewhat similar to those in the *Ascarides*. The orifices on the margins of the Tænia, as was formerly mentioned, have been by some considered as Vaginæ, leading to a set of Vessels filled with a white fluid, considered by some as the Ova, by others as the Chyle. The different kinds of *Tæniæ* are supposed to be Hermaphrodite.

PART

PART IX.

OF ZOOPHYTES.

ZOOPHYTES have, like Worms, a Cuticle, though in some not very distinct, but no part analogous to the Cutis. The Corpus Mucosum is seen only in a few.

The *Echinus* is covered with a Calcareous Skin, upon which are Tubercles regularly disposed; and innumerable Spines, by which the Animal can move in whatever position it happens to be placed. Among the Spines are a set of smaller Bodies, of different forms, which have been sometimes considered as a sort of Antennæ, supplying the place of the Organs of the Senses in the higher classes of Animals.

In the *Asterias*, the covering is of a firm fibrous texture, and has the interstices of the Fibres filled with Calcareous Granulæ. The Body is divided into Radii or Branches, of which there are commonly five, though sometimes a smaller, at other times a greater number. Throughout the whole length of the Branches, several rows of Feet are attached, which give the Animal a certain degree of motion.

The

The *Holothuria* is covered with a thick Coriaceous Skin, which, by means of longitudinal and circular bands of Muscular Fibres, the Animal can shorten or lengthen at pleasure. Some of the Animals of this Genus have numerous Feet, which are either spread over, or situated upon, the side of the Body. In some, the Feet are entirely wanting.

The other orders of Zoophytes have a contractile power residing in their substance, somewhat similar to that of the *Mollusca Nuda*. The *Medusa*, by alternately rendering its Body convex or flat, can so displace the water as to fit it for swimming; but Muscular Fibres cannot be discovered here, probably on account of their transparency.

The *Actinia* has such a contractile power in its Skin, as to assume a variety of forms. It can turn itself into a plain surface, or become cylindrical or conical, &c. at pleasure.

In the *Hydra*, or common *Polypus*, only some moveable Tentacula are found. The small Animals termed *Vorticella* and *Rotifera*, are observed, by the assistance of glasses, to have Cilia of different forms, moving round their axis with great rapidity.

In the Mouth of the *Echinus* are five Teeth of great size, which surround the entry to the Esophagus, and have Muscles for enabling them to masticate their Food.

The *Star-fish* has no Teeth, but a round Mouth, which leads, by a short Esophagus, to the Stomach. The Spines round the Mouth, though not proper Teeth, are observed to lay hold of the prey.

The

The *Holothuria* has a large Mouth, surrounded by semi-osseous Plates, which serve chiefly for the attachment of Muscles and Tentacula. Round the Mouth are Sacs, which open into it, and are supposed to discharge a kind of Saliva.

The *Monades*, and other Microscopical Animals, appear to be extremely simple, having neither any apparent Mouth nor Stomach. They seem to be Gelatinous masses, nourishing themselves by imbibing from their surface.

Nervous System.—No distinct Nervous System has yet been found in this class of Animals.

In the *Echinus*, nothing has been seen which bears any resemblance to Nerves. In the *Asterias* are parts, something similar to them, round the Esophagus. There is a soft white circle, from which Filaments run to each of the Branches of the Animal, and also to the Stomach. Something of a similar nature is seen in the *Holothuria*. Between the different pairs of longitudinal Muscles, a white cord appears, marked with the zig-zag lines seen in the Nerves of other Animals, and seeming also to encircle the Esophagus.

No appearance of Nerves has been detected either in the *Medusa* or the *Actinia*.

In the *Hydra*, or *Polypus with Arms*, and also in Animals the productions of infusion, there is nothing like Nerves, yet they are sensible of heat. They prefer light to darkness, and have so far the sensation of Touch, as to feel the agitation of the water that surrounds them.

The

The different Organs of the Senses are not demonstrable here, though, as in the Vermes, Zoophytes are to be considered as possessing Senses adapted to their manner of living.

Vascular System.—In the *Echinus*, two Vessels run along the Intestines, one considered as an Aorta, the other a Vena Cava, but without any visible Heart. From these a Plexus runs off, to be distributed upon the Intestines and Mesentery. Something of the same kind is to be observed in the *Asterias*.

In the *Echinus*, there is a set of Tubes, considered by DR MONRO as Absorbents, which have a visible Muscular structure, and without Valves. The outer end of each of the Tubes has a flat plate, by which the Animal adheres when it fixes upon any object. In the middle of the plate is an orifice, which imbibes the sea-water, that is conducted to Vessels in the inner part of the Shell. Each of the Ducts perforates the Shell by two Foramina; and the different Foramina are placed in five pairs of parallel lines, called by Naturalists *Ambulacra*, from their similarity to alleys in a garden. Upon the inner side of the Shell, they run to two ranges of Laminæ, composed of Plexus of Vessels, from each of which a Duct runs to a large Tube, which receives all the Absorbents of one of the double ranges. The large Tube terminates in Reservoirs over the Sockets of the Teeth, through which it is supposed, that after a secretion has been made, the fluid absorbed is returned to the sea.

In the *Medusa Rhizostomes*, and the Coriaceous Polypi,

pi, the Vessels which carry the nourishment come directly or indirectly from the Stomach.

In the *Hydra*, or *Polypus with simple Arms*, no Vessels are observed; they imbibe their nourishment by means of the Pores of their Gelatinous covering; and even when their Body is inverted, their external, now becoming an internal surface, is found to digest their Food equally well with the other.

The *Monades*, *Protees*, and other Microscopical Animals, are found to be the most simple of any, appearing to be mere Gelatinous Masses, destitute of Mouth and Stomach, and receiving their nourishment through the surface of their Body. The *Rotifera*, *Vorticella*, and some other equally minute Animals, however, are observed to have a Stomach.

Organs of Respiration.—The Vessels seen on the surface of the Animals of the order *Echinodermata*, as the *Echinus*, and the soft Gelatinous Zoophytes, as the *Medusa*, are supposed by some Authors to draw in nourishment from without, and to serve also as a sort of Respiratory Organs; but these are circumstances not yet fully ascertained. The fresh-water *Polypi*, or *Zoophytes* strictly so called, imbibe nourishment through their whole surface.

Of the order *Infusoria*, or *Animalcula of Infusions*, their diminutive size renders it impossible to ascertain any thing about their nature.

Alimentary Canal and Cavity.—In some of the individuals of the class, there is an Alimentary Canal beginning by a Mouth, and terminating by an Anus. In others there is a Sac, simple or complex. In the first, the

the Canal is sustained by a Mesentery, which fixes it to the walls or covering of the Animal, as in the *Echinodermata*, where, in some of these, as the *Echinus* and *Holothuria*, it makes turns within the Body, and ends in the Anus; in others, as the *Sipunculus*, it is a simple Canal; and in the *Asterias*, a Sac in the centre of the Animal, from which two Canals extend into each of the Branches.

In some of the others, as the *Medusa*, the Alimentary Canal is not suspended by the Mesentery, but is a common Cavity in the general mass.

The Stomach occupies the part termed *Pedicle*. From this Cavity Vessels arise, which convey the nourishment to the different parts of the Body. In some of the *Medusæ*, there is a simple opening; in others, there are Tentacula with open orifices, leading to Canals, that, uniting together, form Trunks which convey the Food into the Stomach. This structure has been compared by CUVIER to the roots of trees, in consequence of which he forms a new Genus, termed *Rhizostoma*, or *Mouth-root*.

The common *Polypus* has the most simple form of the Alimentary Canal, the whole Body being only a kind of Stomach, and having a single opening situated at the centre of the Tentacula, the Animal nourishing its spongy substance by imbibition.

The *Polypi*, which, by their union, form the compound Animals that produce the different Lythophytes, are observed to have a nutritive system something similar to the common *Polypus* and the *Medusa*. They combine the Stomachs of the former with the Vessels of

of the latter. Each *Polypus* has a Stomach, from which Tubes run into the Stalk which supports all the Polypi; here they form a net-work, which occupies the whole of this substance.

The Assistant Chylopoietic Viscera, viz. Liver, Spleen, and Pancreas, are entirely wanting in this class.

Organs of Generation.—All the *Echinodermita* appear to be Hermaphrodite, and possess the power of fecundating themselves. Their Ovaria occupy a great part of their Body, especially when pregnant. Sometimes they are observed to be bathed in a milky liquor, which is supposed to be the Semen.

The *Echinus* has five Lobes in the Ovarium or Roe. These open by several Ducts, which communicate, and pierce the Shell near the Anus. The Ovaria form the eatable part of this Animal.

In the *Asterias*, the Ovaria form also five Lobes, one for each Branch of the Body, and these are composed of the Ova, which have a reddish colour.

In the *Holothuria*, there is a collection of slender Tubes, which greatly extend at particular seasons, and are considered as the Ova; but there is, besides, near the Anus, numerous white spiral Filaments, but whether belonging to the Male Sex is uncertain.

The Zoophytes properly so called, have no Generative Organs; they propagate by Buds and Slips, something after the manner of the growth in Branches of Trees.

In the *Actinia* and *Polypi*, the young sprout out from any part of the external surface of the Parent. When

they are divided, each of the portions forms a perfect Animal.

Corals, Madripores, &c. are compound *Polypi*, fixed upon a Calcareous Base, constructed by the Animals themselves.

Sponges are also compound Animals, having a Vegetating Root and Stem. In their recent state, they consist of an Animal Jelly. The only sign of life in them is a slight tremor and contraction on being touched. After death, the Jelly disappears, nothing but the base of the Animal remaining.

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